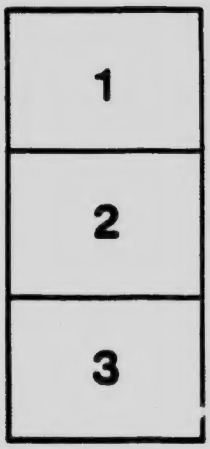

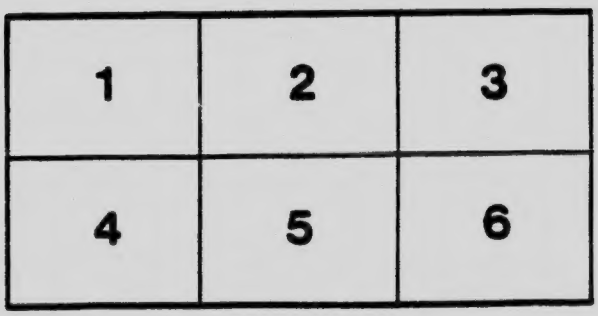

CANADA
DEPARTMENT OF MINES
GEOLOGICAL SURVEY BRANCH.
HON. W. TEMPLEMAN, MINISTER; A. P. LOW, DEPUTY MINISTER;
R. W. BROCK, DIRECTOR.

REPORTS

ON A PORTION OF

ALGOMA AND THUNDER BAY DISTRICTS

ONTARIO

BY

W. J. WILSON

AND ON THE

REGION LYING NORTH OF LAKE SUPERIOR

BETWEEN THE

PIC AND NIPIGON RIVERS

ONTARIO

BY

W. H. CC LINS

OTTAWA
PRINTED BY C. H. PARMELEE, PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1909

Nos. 980 & 1081

Group of Indians at Hudson Bay post, Mammawemattawa, Ont.

CANADA
DEPARTMENT OF MINES
GEOLOGICAL SURVEY BRANCH.
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GEOLOGICAL RECONNAISSANCE

OF A PORTION OF

ALGOMA AND THUNDER BAY DISTRICTS

ONTARIO

BY

W. J. WILSON

OTTAWA
PRINTED BY C. H. PARMELEE, PRINTER TO THE KING'S MOST
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1909

No. 980

R. W. BROCK, Esq.,

Director Geological Survey,

Department of Mines.

SIR,—I beg leave to submit the following Report on a Geological Reconnaissance of a portion of Algoma and Thunder Bay districts, Ontario.

I have the honour to be, sir,

Your obedient servant,

W. J. WILSON.

OTTAWA, March 13, 1908.

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ILLUSTRATIONS

GEOLOGICAL RECONNAISSANCE

OF A PORTION OF

ALGOMA AND THUNDER BAY DISTRICTS

ONTARIO

BY

W. J. Wilson.

The area included in the present report is in northwestern Ontario, and lies between 48° 30′, and 51° north latitude, and 84°, and 87° 30′ west longitude. This region was examined during the summers of 1903-4, and comparatively full reports of the work done were published in the Summary Reports of the Geological Survey of Canada for those years. A map (No. 964)—on a scale of 8 miles to 1 inch—has already been published; and as the opening out of these districts by the Transcontinental railway has given commercial importance thereto, it has been deemed advisable to embody the main facts relating to the topography, geology and economic resources of the country in one general report, to be accompanied by the map referred to.

Most of the area examined is drained by tributaries of the Albany river, including the Little Current, Drowning, Kenogami, Pagwachuan, Nagagami, and Kebinakagami rivers. These waterways were used as canoe routes in passing through the country. The district as a whole is comparatively flat, the height-of-land being about 1,200 feet above sea level. The watershed between the St. Lawrence and Hudson Bay waters is rather a broad plateau than a sharp dividing ridge. The streams running through this plateau rise in swamps, muskegs and lakes, and are winding and sluggish, but can usually be navigated with canoes to their source. North of this plateau the country descends somewhat rapidly until the sedimentary rocks are reached, and all the rivers have many rapids and falls in this stretch, from which almost unlimited waterpower can be developed. As the route of the National Transcontinental railway

passes through this slope for a long distance, there is little doubt that these waterpowers will be utilized in the near future. Northeast of this slope the coastal plain extends to James bay. The descent is about 400 feet in the whole distance. The rivers through this plain are broad and shallow, with an even, swift current and an occasional slight rapid. None of the rapids, however, require portages.

GENERAL GEOLOGY.

Considerable diversity prevails in the character of the rocks of this area. Laurentian granite and gneiss occupy the greater part, extending from the southern boundary of the area mapped over the height-of-land and well down the Hudson Bay slope. From McKay lake to O'Sullivan lake the continuity of the granite is broken by considerable areas of hornblende schist, biotite schist and diabase, the latter mostly in narrow dikes, though sometimes in larger masses. These rocks were formerly mapped as Huronian, but most of them probably belong to what is now called Keewatin. Northeast of the granite and gneiss, and extending to James bay, there is an immense plain underlain by dolomitic rocks lying almost flat, or dipping slightly to the northeast. The portion of this included in the map embraces parts of the Cambro-Silurian and Silurian systems, ranging from the Black River to the Guelph formations. A list of fossils from these rocks, identified by Mr. J. F. Whiteaves of the Geological Survey, is appended.

GRANITE AND GNEISS.

Over a hundred slides were prepared from the rocks collected in the area under consideration. These were examined by Mr. G. A. Young, petrologist to the Geological Survey, and the following microscopical descriptions are from his report. After describing a few slides which showed peculiarities, and which will be noted in dealing with the regional geology, he says of the remaining granite and gneiss specimens: "The remaining rocks of this group while differing in their mineral composition, structure and general appearance, are alike in that they all possess features indicating an igneous not a sedimentary origin. According to mineral composition and structure they might be classed as muscovite and biotite granites and gneisses; the latter, in many cases at least, owe their structures to crushing and were originally granites. Any subdivision into varieties would likely result in the separation of rocks genetically related, and the grouping together of others which the field evidence would prob-

ably separate. Instead it is proposed to describe the remaining rocks of this group as a whole.

'Many of the specimens present the features of medium to fine grained, pink or grey granites. The visible coloured constituent is invariably biotite or muscovite, sometimes both; the microscopic examination of thin sections revealed hornblende in a few instances only, and then in very subordinate amounts. In the grey varieties, biotite is always the predominant and usually the only mica present, and is sometimes very abundant. In the pink varieties mica is, on the whole, much less abundant, and is frequently largely or almost altogether muscovite. In a number of instances the arrangement of the mica flakes imparts a foliated structure to the rock, and in a few cases this is accompanied by banding. It would be possible to select a series of specimens showing a gradation from typical granites into well banded gneisses.

'The feldspars which so largely compose the rocks, comprise plagioclase, orthoclase and microcline. Both monoclinic and triclinic varieties are always present, the relative amounts varying from section to section. In general the amount of microcline, as compared with that of orthoclase, increases with increasing deformation of the rocks as the result of pressure. Quartz is always abundant, but occurs in varying amounts.

'Amongst the accessory minerals, apatite, pyrite and magnetite are often present. Grains of sphene are common. Allanite occurs in a number of sections sometimes included in irregular grains of epidote, sometimes alone. Garnets occur in only two sections.

'A large proportion of the rocks has been subjected to dynamic stresses. In some cases this is shown only by a wavy extinction of the quartz individuals. In other instances the quartz grains have partly or wholly yielded to the strain with only partial deformation of the feldspathic constituents. In many cases the margins of the feldspars have been crenulated, and in other instances the crushing has gone so far that, of the once large individuals of feldspar, only irregular grains are left, embedded in a granular mass of quartz and feldspar. This crushing sometimes seems to have led to the formation of large muscovite flakes which lie, without any twisting or bending, in highly crushed and sheared rocks. In fact the muscovite of all the rocks examined seems to have had a secondary origin. In many cases the biotite seems also to have developed with the crushing, and this mica, when fresh, has the peculiar brown colour of secondary

biotite. In a number of instances the crushing of the constitue seems to have been followed by a recrystallization of the materials, that the grains, instead of intricately interlocking with one anoth have polygonal outlines.'

FINE GRAINED BIOTITE GNEISS.

Associated with the granite and gneisses there are bands of fine grained biotite gneiss, which it is impossible to separate from t former as they grade from one to the other without any break. The bands are sometimes of considerable size, and are distributed ov large areas. They are particularly abundant along Little Curre river and Percy lake.

The specimens belonging to this group vary in grain from f to medium, and in colour from dark to light grey. They are co posed chiefly of biotite, feldspar and quartz, and each specimen characterized by the uniformity of size of grain and distribution its component minerals. These rocks are distinguished from the b tite schists, into which they seem to merge, through the lack of prominent slate-like parting, by a decrease in the amount of mi and by an increased coarseness of grain. The black biotite scales a always parallel to one another, and give rise to a very prominc foliated structure, while the mineral is so abundant that the ro tends to cleave along planes parallel to the foliation, and the surfaces of fracture glisten from the abundance of the mica. Ma of the specimens hold minute, wine-coloured garnets, and in o instance the rock contains many relatively large flakes of muscovi These gneisses are rusty weathering, and in a few instances appe to be banded because of the alteration of the mica to chlorite, and t decomposition of the feldspars along narrow bands parallel to t plane of foliation.

'As seen under the microscope, the rocks are composed esse tially of biotite, plagioclase feldspar, orthoclase and quartz. Among the accessory constituents, apatite, pyrite and magnetite are almo invariably present. Over one-half of the sections contain garne muscovite is present in three, cordierite in two, microcline in o and sillimanite in one. The biotite is pleochroic, from pale yellow dark coffee-brown, and usually exhibits prominent pleochroic ha about minute inclusions. Basal sections of the flakes are never id morphic, and are sometimes highly irregular. Prismatic sections a often lath-like, but more commonly are irregular, their outlines bei

modified by the forms of the neighbouring grains of feldspar and quartz.

'On the whole, the individuals of quartz and feldspar have rounded outlines, and in any one section are of about the same average diameter. There is, however, a tendency for the quartz grains to assume more irregular shapes and smaller forms than the feldspar, and this sometimes seems to be more prominent in the coarser varieties, and there, rarely, is accompanied by a disposition of the feldspars to assume broader, tabular-like outlines. The section showing this tendency of the feldspars towards idiomorphism most prominently also contains a few small, irregular grains of microcline.

'Pyrite and magnetite are never abundant; the former sometimes occurs in cubes. The apatite takes the form of minute prisms usually associated with the biotite. Garnets are abundant in some sections, sparingly present in others, and entirely absent from many. The mineral is almost colourless, sometimes has crystal boundaries, but often has irregular outlines or occurs in very small grains. The larger individuals at times contain many small rounded grains of quartz and feldspar. These inclusions are sometimes so abundant that the garnet becomes a mere network surrounding the foreign particle. Two sections contain a few small shreds of muscovite, while one section holds a number of large flakes of this mica, often including small quartz grains. Cordierite occurs in two sections, in one as small rounded, prism-like forms, in the second it is more abundant, and has irregular outlines, the grains often containing small inclusions of feldspar. The mineral is colourless, but shows the characteristic yellow pleochroism in spots, and about minute inclusions. Sillimanite occurs in one section, where it is very abundant, and there assumes the form of large and small matted aggregates.

'The relative amounts of the chief constituents vary independently of one another from section to section. In many instances quartz is much more abundant than the feldspar, but in several cases it is greatly exceeded by them. Sometimes orthoclase is the predominant feldspar, sometimes plagioclase.

'The arrangement of the abundant biotite gives usually a very distinct foliated character to the section. In one instance the mica is more abundant along certain somewhat coarser bands, which also seem to be richer in feldspar.

'The characteristic features of all the sections are the rounded or sub-angular forms of the component grains, the uniformity in size and distribution of the minerals in each section, and the presence of

abundant brown mica. In only one section is there even an approach towards idiomorphism on the part of one mineral towards another. The present structures have evidently resulted from recrystallization. The original rocks, as far as the microscopic evidence goes, may have been either of sedimentary or igneous origin.'

Gneisses very similar to many of the above have been described by Lawson[1] as belonging to the Couchiching series of the Rainy Lake district, a formation which he regarded as of sedimentary origin. Some of the gneisses also resemble in a way the sillimanite and garnet bearing gneisses of the Grenville district as described by Adams,[2] and, in certain cases, shown by him to be of sedimentary origin.

KEEWATIN.

Along the Kawashkagama river from Rupert fall to Abamisagi lake there is a considerable area of dark and greenish hornblende schist which has been assigned to the Keewatin system, and similar rocks were noted on Nagagami river and parts of O'Sullivan lake. There are probably other small areas of the same rock, but the examination was not made in sufficient detail to warrant their separation.

Hornblende Schists.

These rocks vary in grain from fine to almost dense, and in colour from black or greenish black to dark grey. The very dark colours are due to the great abundance of hornblende occurring in tiny grains, which with the minute grains of feldspar and quartz give a speckled appearance to the hand specimens. In some instances biotite is also abundant, and the flakes, lying parallel to one another, impart a very evident foliated structure to the rock. Some of the specimens, richer in biotite, feldspar and quartz, closely resemble the finer grained types of biotite-gneiss.

'Under the microscope the majority of the rocks are seen to be composed chiefly of hornblende, plagioclase feldspar, orthoclase and quartz. In a number of instances biotite is also present, and is sometimes very abundant. Magnetite and apatite are common accessory minerals, sphene is sometimes abundant and pyroxene is present in a few instances.

'The hornblende is of a green colour, has a well developed prismatic cleavage, and occurs almost altogether in small granular forms.

[1] Ann. Rept. G.S.C., Vol. III., Part 1, 1887-88, p. 109 F.
[2] Ann. Rept. G.S.C., Vol. VIII., 1895, p. 49 J.

The biotite is a brown variety. The comparatively rare pyroxene is of a light green colour, and always lacks crystal boundaries. The feldspars and quartz have granular forms.

'The relative proportions of the chief constituents vary greatly from section to section. Hornblende is usually very abundant and in some cases at least forms two-thirds of the section. Biotite is often completely absent, but in a few instances is very plentiful; at times it greatly exceeds the hornblende and with increasing amounts of feldspar and quartz, provides forms allied in composition and structure to the biotite-gneisses. The feldspars and quartz also show large variations in amount; sometimes plagioclase feldspar, sometimes quartz, is practically the only coloured constituent present.

'The structure is eminently granular, the chief constituents are evenly distributed and are usually of about the same size and shape in any one section. The biotite, however, is always rather idiomorphic, and when at all abundant imparts a very distinct foliation to the rocks.'

These rocks present no trace of their original structures. Lawson,[1] however, has described somewhat similar rocks from the Rainy River district, which from their field relations he thought might be partly derived from tuffs, partly from massive igneous rocks. It is possible that the rocks described above may have had a similar origin.

The banks of part of the Kawashkagama river above O'Sullivan lake and the western part of the lake are occupied by very fine, slate-like biotite and chlorite schists, which may belong to the Huronian system, but it has not been thought advisable to attempt to separate them from the hornblende schists just described. These rocks are thus described by Mr. G. A. Young:—

'The rocks of this group are characterized by very fine grain, dark colour, foliated structure, and prominent parting, which is sometimes smooth and slate-like, sometimes curved and uneven. The fresher specimens, on their parting planes, exhibit a sheen caused by a nearly continuous film of scales of dark brown biotite; on surfaces at right angles to the plane of schistosity the rocks are seen to be of a dark grey colour, very fine grain and highly siliceous. The curving and uneven fracture plane of one specimen is marked by large and small lumps about which curve the flakes of mica. These lumps suggest the presence of andalusite; but this mineral, if once present,

[1] Ann Rept. G.S.C., Vol. III., Part 1, p. 37 F.

is represented now only by aggregates of muscovite. The rocks are rusty weathering, and in one instance the complete alteration of the mica to chlorite has given the specimen a decided green colour.

'As seen under the microscope the rocks are essentially composed of biotite, quartz and feldspar, and while in some cases the latter mineral is very abundant, in others the sections are almost free from it. One contains a few very small grains of garnet, and two others hold muscovite. Magnetite or its decomposition products are present in nearly all of the sections, but only in small quantities.

'The biotite, when fresh, is pleochroic, from a pale yellow to a brown colour such as is often seen in secondary mica. It forms small, narrow, irregular flakes. In one section the large flakes occasionally enclose minute grains of quartz. Small flakes of muscovite occur in two sections, somewhat irregularly distributed and usually associated with biotite. In one rock, as already mentioned, this mica forms aggregates of comparatively large flakes, probably derived from andalusite. The quartz and feldspar form small angular or rounded grains. Those of feldspar are usually sub-angular, or rounded, while the quartz individuals are commonly much more irregular. The feldspar, when present, appears to be almost entirely orthoclase. The quartz usually exhibits a wavy extinction which, in the case of the larger grains, is often accompanied by an incipient fracturing as the result of pressure.

'The rocks are all very fine, and even grained. The prominent foliated structure is due to the parallel arrangement of the flakes of mica, and in a lesser degree, to a similar arrangement of the larger axes of the quartz and feldspar grains. The biotite flakes, while usually rudely prismatic, always lie between the other constituents, never penetrating them. The constituents are never idiomorphic towards one another; instead the evenness of grain and rounded form of the quartz and feldspar individuals are very characteristic of these sections. It is evident that the present structures have resulted from the recrystallization of a previously existing rock. In some of the sections the distribution of the minerals is quite uniform, in others the mica tends to lie more abundantly along certain lines and bands, and this arrangement of the mica is sometimes accompanied by a similar disposition of the feldspar.

The mineralogical composition and general structure of these rocks indicate that they are probably of sedimentary origin.

DIABASE.

Dikes of diabase varying from one inch to fifty feet in width, are common both in the granites and schists, and in a few places larger masses of this rock were noted. Of the specimens brought in, Mr. G. A. Young says they are all of ordinary types of diabase, in no instances holding olivine. One specimen is porphyritic, and a second shows a fine grained porphyritic contact facies.

CAMBRO-SILURIAN AND SILURIAN.

The northeast part of the sheet is occupied with sedimentary rocks lying in an almost horizontal position. These rocks are exposed in the banks of all the rivers from the Albany to the Kebinakagami. As the whole country is deeply covered with clay the only outcrops are in the rivers where the rocks are exposed in the banks and bed. In the latter case they usually form broad, shallow rapids, sometimes extending several miles at a stretch, as on the Kebinakagami river. Where the rock is first seen on the lower parts of the rivers it consists of a very soft argillaceous, grey dolomite, associated with rock of a similar character, but of a brick red colour. In places there are bands of a mottled red and grey rock. These red and grey rocks are so soft that they can be easily cut with a knife. They are seen on all the rivers examined, and in mode of occurrence and general appearance are identical with the rocks on the Kapiskau and Abitibi rivers. [1] A careful search revealed no fossils in these rocks. Ascending the rivers, however, a harder, buff, to cream coloured rock outcrops, which in places abounds in fossils, and from which collections were made. These fossils were examined by Mr. J. F. Whiteaves, of this office, whose report is appended. As determined by Mr. Whiteaves, the fossils indicate that the rocks are Cambro-Silurian and Silurian, the former being represented by the Black River and Hudson River (Richmond) formation, and the latter probably by the Niagara or Guelph.

A partial analysis made by Mr. M. F. Connor shows that the rocks are dolomites. Five specimens representing different phases of the rock gave the following results:—

Specimen.	1.	2.	3.	4.	5.
Silica and insoluble..	4·4	32·2	1·8	36·0	36·0
Magnesium carbonate....	40·4	27·8	43·2	26·6	27·0
Calcium carbonate...	51·7	33·2	52·4	33·1	31·1

[1] Summary Report G.S.C., 1902. p. 222.

DESCRIPTION OF ROUTES.

THE LITTLE CURRENT AND KAWASHKAGAMA RIVERS.

The Little Current is the largest branch of the Kenogami. It enters the latter fourteen miles from the Forks on the Albany river, and rises northwest of Long lake, south of 50° north latitude. It has a total length of 260 miles following the bends of the river. The upper part is named by the Indians, Kawakashkagama, which the Geographic Board has shortened to Kawashkagama. It drains Mountain, Egg, Island Camp, Fleming and Kawashkagama lakes. This part of the river was examined by Dr. R. Bell, and is described in the Annual Report of the Geological Survey for 1870-1, p. 244; also by party number 5, Exploration of Northern Ontario, issued by Ontario Legislative Assembly, Department of Crown Lands, 1900, p. 138. For two miles below Kawashkagama lake the river is broad, with slow current. At this distance a portage leads to Wawong lake. Below this portage the river is from one and a half to two chains wide, and fairly deep. Between the portage and Rupert fall—a distance of eleven miles—there are only two rapids, and these can be run with loaded canoes at ordinary water. There is a good portage at each.

At Rupert fall there is a drop of fifteen feet over much broken and disturbed ledges of dark green hornblende-schist dipping S.40E<70. Past this fall there is a five chain portage on the north bank. The river continues in a northwesterly direction for twenty-two miles and is about two chains wide. It then flows northeast for four miles, when it turns almost due north and flows in that direction to Abamisagi lake. Between Rupert fall and Abamisagi lake there are two portages, the first to pass a log jam near the bend, and Howard fall four and a half miles farther down. This fall is caused by a ridge of chloritic hornblende-schist through which the river cuts, making a narrow canyon-like gorge fourteen chains long. This gorge is from twenty to thirty feet deep, and the water descends in steps and slides varying from one to five feet. The fall would make a splendid waterpower. From Howard fall to Abamisagi lake, eleven and a half miles, there are three rapids, two of which require short portages.

The river is from two to three chains wide, with slow current. It enters Abamisagi lake from the south, and turns round, as the Indian name of the lake implies, and flows towards the south for a

Plate II

Howard Fall, Kawashkagama River, Ont.

828 p. 10

short distance. The distance between the entrance and the outlet is less than half a mile. The river then flows east for eight miles to O'Sullivan lake. In this distance the river is wide and deep, and there are three bad rapids which cannot be run with loaded canoes.

The main part of Abamisagi lake is eight miles long and two and a half broad, with regular shores and few islands. There is a narrow bay to the northeast, which I was told extends three or four miles in that direction.

O'SULLIVAN LAKE.

O'Sullivan lake is very irregular in shape: for nine miles it lies northeast, following the course of the river. In this distance it is about a mile wide, but narrows considerably in one or two places. The larger body of the lake lies southeast from the inlet, extending in that direction five miles. This part is cut up by long peninsulas and islands, some of which are large, especially in the east. The Indian name Sesekenaga signifies that the lake has many islands clustered together in groups. Its shores are mostly low, but in places, especially on the northeast, the rocks rise abruptly from the water to a height of 40 feet. On the southwest the land slopes gently back from the lake to a height of 200 feet, and at a distance of about four miles there is a prominent hill which rises much higher. This hill is a conspicuous object both from Eskegenaga and Abamisagi lakes. The forest round this lake is mostly second growth.

Between O'Sullivan and Percy lakes there is a succession of lake expansions, some four miles long, connected by stretches of rapid water and falls which necessitate eight short portages. Percy lake is eight miles long and a mile and a half broad. The longer axis has an east and west direction, the Little Current entering a mile from the west end. At the extreme west end this lake receives another rapid river, which appears to be about the same size as the Little Current. From information gathered from the Indians it is inferred that this is probably the Kapikotongwa river, which forms part of the canoe route from Lake Nipigon to the Albany river. A well travelled route from near the north end of O'Sullivan lake connects, through a chain of lakes, with the Kapikotongwa river some distance west of Percy lake.

For sixteen miles below Percy lake the river is broad and deep, with sluggish current. At this distance there is a beautiful fall, twenty-four feet high, divided into two drops of equal height. It is

also divided in the middle by an island. Below this to the contact of the Palæozoic and Archæan rocks the river is narrower and rapids are common. In this distance there are ten portages. In some places the river runs in narrow gorges through gneiss which forms steep walls thirty to forty feet high, the river itself being less than a chain wide. There are many excellent waterpowers along this stretch. A short distance below the above contact a large stream enters from the south, and is probably the river that drains Eskegenaga lake. The Indians say it forms a canoe route to Long Lake House, and they describe it as very rapid with many portages. Near the mouth it is 230 feet wide and 4 feet deep, with slow current. Where this branch enters, the main river is over six chains (435 feet) wide. From this point to the mouth there are no portages, though there are occasional rapids or stretches of swift water where the river is wide and shallow. In this part of its course it has cut a channel through the clay or soft rock, the whole country being comparatively flat, and no distinct valley with sloping banks is seen. The clay banks in places rise fifty feet above the river, but generally they are much lower, usually ranging from five to ten feet. Along the river on both sides there is a narrow strip of well drained, fertile soil on which is growing, when not destroyed by fire, fair sized trees of spruce, poplar, Balm of Gilead, tamarack, canoe-birch and fir, with mountain maple and numerous shrubs and plants. In some places this fertile strip is only a chain or two wide, while in others it goes back for a considerable distance. Beyond, or inland from this, the soil is covered with a deep layer of peaty moss saturated with cold water, the forest growth being stunted spruce and tamarack. The temperature of a small stream trickling from this muskeg was 36° Fahr. in July, while the water in the river was 70° Fahr.

From personal observation and from information furnished by the Indians who hunt in this river, it is inferred that this is the general character of the adjacent country, underlain by the dolomitic rocks. Where the rocks are Archæan, gneissic ridges give a rolling appearance to the country and afford better drainage, making the land more suitable for agricultural purposes. It is also better wooded, some spruce trees reaching a diameter of 2 feet. Unfortunately considerable areas have been burned at different times, so that a small dense second growth covers much of the ground, the trees averaging from 4″ to 12″ in diameter.

ROUTE FROM KAWASHKAGAMA RIVER TO DROWNING RIVER.

Two miles below Kawashkagama lake a portage of sixty-seven chains over sandy Banksian pine ridges and spruce swamps leads to Wawong lake. This lake is two and a half miles long. The shore line is very irregular, numerous sand and gravel ridges extending into the lake, forming deep bays. In two places a portage of only ten to twenty feet across a low neck of sand was required to pass from one bay to the other. The lake is surrounded by a rolling sandy country, covered, for the most part, by Banksian pine and poplar. The water, as the Indian name implies, is very clear, and of a peculiar bluish-green colour. From Wawong lake the canoe route runs northeast through four small ponds and five short portages to Eskegenaga lake, a distance of a little over two miles. Most of the country along this route is similar to that round Wawong lake, with some areas of good soil well wooded. There are no rock exposures.

ESKEGENAGA LAKE.

Eskegenaga (raw bones) lake is over twelve miles long, and averages about three miles in breadth. There are seven deep bays, and the whole shore line is irregular. The lake is full of islands, some of considerable size, especially in the eastern rt. Two or three small streams enter the lake. The outlet, which flows into the Little Current river, is from the northeast arm, and at a distance of about a mile from the lake becomes rapid and shallow. Several soundings were taken in the lake, showing a maximum depth of fifty-six feet. Depths of between forty and fifty feet were common near the middle. The surrounding land is generally low, but on the south an occasional hill rises 200 to 300 feet above the level of the water. Except in a few limited areas the forest growth is all small, being about thirty years old.

The portage eastward from Eskegenaga lake is from the east bay, and is half a mile long. It is chiefly through a sphagnum swamp almost muskeg in places. Groves of tall slender spruce 8″ in diameter occur near the lake. This spruce would make good pulpwood. Tamarack and cedar also grow on this portage. A small lake and short portage come next, then follows Collins lake, which is over five miles long and less than a mile broad. It contains numerous islands and drains east, but the stream out of this lake is not followed; instead two portages and a small lake to the north are used. On these portages and lakes there are some large spruce and

poplar. The next lake is one of considerable size, and the Indians say the stream flowing from it forms an excellent canoe route to the Little Current river. The lake extends eastward for a long distance and is shallow in places. The portage out of it is a mile and a quarter in length and is through a spruce swamp which at the east end is rather open muskeg. The next lake is small, and the portage from it leads into Wababimiga lake. This portage is over a steep hill, and has some excellent forest on it.

WABABIMIGA LAKE.

Wababimiga lake is so named by the Indians on account of the white glistening colour of the leaves of the young poplar and canoe-birch which grow abundantly on its shores. It is six and a half miles long and from one to two miles wide. The greatest depth found was forty-two feet. The land on the south and southwest is rather low and flat, and covered with a second growth of small trees, while on the north there are some low hills covered heavily with a forest from fifty to a hundred years old, in which there are some large trees. The Wababimiga river flows in a northeasterly direction from the east end of the lake, and joins the Drowning river. It is about ten miles long, and is a clear shallow stream flowing over a gravelly bottom. It is with difficulty that it can be navigated with light canoes in ordinary water. The banks are sandy or gravelly and in most places are covered with Banksian pine.

The route eastward from Wababimiga lake follows a deep bay to the south, and then a small brook running into it for a mile and a half, when a series of five portages and four lakes lead to Drowning river, a distance of seven miles. The five portages aggregate over three miles, and the lakes are all very small except the most easterly which is two miles long. The first portage on the west is over burnt ground with scattered Banksian pine thirty years old. The other portages are mostly through sphagnum swamps, with dense forests of black spruce and tamarack. Some of the spruce measure 10″ to 12″ in diameter, but the average is from 6″ to 9″. These swamps would produce large quantities of pulpwood, as the trees are tall and taper very little for a long distance up. Grey gneiss and hornblende schist were the only rocks seen in this distance.

THE DROWNING RIVER.

The Drowning river enters the Kenogami four miles south of the Little Current, and for thirty miles these two rivers are only

Rapids on the Drowning River above the mouth of the Wababiniga River, Ont.

four to six miles apart, and are roughly parallel for 130 miles. At seventy-five miles the river divides into two streams of nearly equal size. The eastern branch was not explored, but the guide said that at some distance from the forks it also divides into two equal parts. The Indians call it Nameigus or Trout river. The western branch rises in Nestabon lake, which is only about five miles north of Round lake on the Devilfish River route. Nestabon lake is ten miles long, and is divided into two equal parts by a narrows over half a mile long. The National Transcontinental Railway line crosses at this narrows. The lake is from a mile to a mile and a half broad, and in one place in the northern half a depth of seventy-eight feet was found. The Indians say that this part of the lake never freezes. The surrounding land is generally low and flat, except on the west side of the lower part, where there are hills 150 feet high. The forest is chiefly second growth and small. For a distance of thirty-one miles below the lake the forest has been recently burnt over extensive areas, leaving clusters of large trees. In this distance there are five short portages and three lake expansions. Below this to the mouth of the Wababimiga branch the river is two chains wide, and forms an easy canoe route, as the portages are all short and most of the rapids can be run by empty or partly loaded canoes. The country is low and level, and the soil is mostly a clay loam deeply moss covered, with occasional areas of sand. Spruce is the principal tree along this stretch. Many of the trees are 20″ diameter, and are large enough to make good sawlogs, while the majority would make good pulpwood. They grow straight and tall, reaching a height of sixty feet or more, and carry their size well up. Small black ash was noted at one place.

Rapids on the Drowning River above the mouth of the Wababimiga River, Ont.

The remaining 135 miles of the Drowning river were surveyed and examined by Mr. O'Sullivan, who assisted me in 1903, and the following description is compiled from his notes. For thirty-three miles below the mouth of the Wababimiga river good mixed timber covers the loamy soil, thence for twelve miles the country was burned over some twenty years ago. From the fifty-fifth to the twenty-fifth mile from the mouth another burnt area is crossed. The second growth of poplar and canoe-birch on this is probably twenty years old. Along the remainder of its course to the Kenogami river the banks are well wooded with spruce, poplar, canoe-birch, tamarack, fir and Banksian pine, the spruce and poplar being from 4″ to 18″ diameter. As on the Little Current and other rivers flowing through

the costal plain, these large trees ex[illegible]nd only for a short dista from the river, where the edge of the in[illegible]nd muskeg is reached. groves were noted near the mouth of the Drowning river, and b ash and elm are common along the Kenogami from Mammawe tawa to the mouth of the Little Current.

For twenty-five miles from the mouth the waters of the Dro ing river are swift, with a number of shallow rapids over dolo ledges; the strongest of these rapids have a fall of ten feet in a mile. Along this part of the river the clay banks rise in place a height of fifty feet.

From the Drowning river there are two canoe routes to Kenogami. One of these leaves the former river about two above the portage from Wababimiga lake, and the other begi the east side of the upper half of Nestabon lake where a small st enters. The first portage on this route is about three miles though in high water, where the stream flowing into Nestabon is used, there is a break of less than half a mile. This porta through a spruce swamp for nearly the whole distance; it is and where not too wet is a good trail. Spruce and tamarack abundantly, and average 8″ to 10″; some spruce reaching diameter. They grow tall, and would yield large quantities of wood. This portage leads into Atik lake which is three miles and very shallow. Atik lake is drained by a small shallow st which flows into Kawakanika lake. The land drained by this s is swampy and low, and is densely wooded with small spruce. than half a mile from Kawakanika lake the eastern canoe route this one. Kawakanika is a beautiful lake, abounding in fish, a this account is much frequented by Indians in summer. Fro lake a hilly portage half a mile long, well wooded with spruc cedar, leads to another beautiful lake of clear water named W by the Indians. The trail from Wawong lake to the Kenogami is a mile long, and is through a forest of old growth with ar good agricultural land especially near the river. On the canoe route the portages are shorter, and pass through a level s country, densely wooded, chiefly with spruce.

PAGWACHUAN LAKE AND RIVER.

In passing from McKay lake, the source of the Pic ri Pagwachuan lake there are six small lakes or ponds and five po The latter have a total length of a little over four miles and,

the last, are over dry sandy ground on which Banksian pine and poplar are growing. The portage into Pagwachuan lake is nearly two and a half miles long. The first mile going northeast is well wooded with large canoe-birch, spruce and poplar, and the soil is good. Then for half a mile there is a sandy Banksian pine plain, and the last mile is through a wet, sphagnum swamp. The height-of-land between the fourth and fifth lakes is 55 feet above McKay lake and 150 feet above Pagwachuan lake. The latter is about 900 feet above sea level, and is eleven miles long, varying from two miles to half a mile in width. Occasionally low hills, from 75 to 100 feet, rise from the shores, and a thick growth of small spruce, poplar, fir, canoe-birch, tamarack and cedar is found everywhere around the lake.

The river leaves Pagwachuan lake at the extreme eastern end. There are two short portages in the first four mil and two lake expansions, from the lower of which the canoe route leaves the river and follows a lake on the north side for four miles. In the remaining five miles to the river there are two portages, each considerably over two miles long, with a small lake between. The land along this route is poor. The guide described the part of the river avoided by this detour as blocked with driftwood, and said that about a mile below the point where the route turns off there is a fall of 150 feet, with many rapids below. The river is fifty feet wide, with slow current, where it connects with the portage at the east end.

For twenty-six miles below this portage the river runs almost due east, and is from one to two chains wide, with numerous rapids, but only two short portages. The low clay banks are densely wooded, for the most part with large spruce, poplar and cedar. The country back from the river is sometimes undulating, but no high hills were seen. The soil along the river, where the drainage is good, is of excellent quality. The river then turns north and flows in that direction for thirty miles. The National Transcontinental Railway line crosses near the northern end of this stretch. The trail line, 1904, crosses about four miles north of the bend. The country here is rolling, with low rocky and sandy hills covered with second growth Banksian pine and poplar fifteen years old. The river at this point is 537 feet above sea level, as determined by the railway engineers. Two miles farther down there are a fall and portage, with a drop of eighteen feet. Continuing north, the river becomes broader, with numerous shallow rapids. The banks in places are high, showing

twenty to forty feet of clay, sand or gravel, usually containin
striated boulders in the lower part, with more or less distinct strati
cation above. There are areas of old forest growth alternating wi
others of small and medium sized second growth. Some of the spru
close to the river measure 18" to 2 feet diameter, and numerous a
and elm trees line the banks. Some of the elms are very gracef
trees 25 feet high, and 10" to 12" diameter.

For the last thirty-five miles the river runs northeast. It
from four to six chains wide, and is very shallow, with a swi
current and many rapids. The Indian word Pagwachuan mea
shallow current, and was doubtless first applied to this part of th
river. The clay banks are low, seldom rising above fifteen feet, an
the whole country, as far as can be seen from the river, is flat. Th
last twenty-two miles were swept by fire in 1901 and a large area
forest destroyed.

THE NAGAGAMI RIVER.

The Nagagami river enters the Kenogami river one mile and
half above the Hudson's Bay Company's post at Mammawemattaw
It is four chains wide at its mouth, and discharges a large volume
water. For thirty-five miles from the mouth it flows with a modera
current and occasional rapids between clay banks ten to forty fe
high. At this distance, the flat dolomite comes to the surface an
the river becomes wider, in some places measuring eight to te
chains. Before reaching the first portage there are two rapids, ea
about half a mile long, which are too shallow in low water to flo
loaded canoes.

For the first ten miles the forest was destroyed by fire in 190
and above this there is a large second growth of the usual trees, wi
a few small elm and black ash. The larger of these trees measu
from 4" to 12" in diameter.

At the forty-ninth mile, the first portage occurs. It is ov
exposed granite rock along the west bank and is nineteen chains
length. In less than a mile there are two more short portages, th
river having a total descent of twenty-seven feet. The greatest fa
in the river is at Highwood portage, fourteen miles farther up, whe
for two miles there is a series of rapids and chutes with a total fa
of 160 feet. The portage is on the west bank and is 156 chains lon
but is divided into two parts by a small lake. The country he
is well wooded, some of the spruce measuring over 2 feet diamete

Burnt Country near the mouth of the Pagwachuan River, Ont

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There are also large canoe-birch, poplar and tamarack trees, but the south end of the trail has been recently burned. The soil is a clay loam and is of excellent quality. Highrock portage, one mile long, is six miles farther up, and here the fall is 102 feet. Almost adjoining this is Jackpine portage, with a dr of twenty-three feet. The National Transcontinental Railway line crosses about a mile below Highwood portage, so that within a distance of seven or eight miles there is a fall in the river of 200 feet. This great water-power will thus be readily available for motive power on the railway, or for any other purpose for which it may be required. The Nagagamisis enters the Nagagami about a mile below the railway line, and at its mouth there is a fall of thirty-five feet, which would make a good water-power. There are altogether thirteen portages up to Nagagami lake, but none of them exceed half a mile in length, except the three named, and some are only a few chains long. For the greater part of the distance between Jackpine portage and Nagagami lake, close to the river, the land is low and swampy, but at some distance back there are undulations and low hills which afford better drainage. Second growth timber covers most of this tract, but there are some good spruce and poplar near the lake.

NAGAGAMI LAKE.

Nagagami lake is six miles and a half long by four and a half wide, and in places, not far from the western shore, it is forty feet deep. Above the lake the river is much smaller and is very crooked, with numerous rapids and boulders. In places the overhanging trees meet from opposite sides. Between Nagagami lake and Obakamiga lake, a distance of twenty-eight miles, there are nine portages. Elbow portage is one mile long and has a fall of thirty-five feet, and Loop portage, two miles farther south, is forty-eight chains long with a fall of thirty-three feet. All the rest are short. Looking southward from Nagagami lake the country is somewhat hilly, and seven isolated peaks are visible rising 500 to 700 feet above its surface. To the east one or two hills are seen, but north and west the country is comparatively flat. The country between the lakes is wooded with the usual trees, but large areas were burnt thirty years ago or more and are now covered with a dense growth of small spruce and poplar.

OBAKAMIGA LAKE.

Obakamiga lake is about twenty miles long and is very irregula in shape. It is in two parts, connected by a river-like narrows whic seems to have no current. The northern part is cut in two by a lon peninsula, and the southern part extends to the height-of-land portag It is largely surrounded by granite hills, some of which are bare, an others covered with a small second growth of timber intersperse with clumps of the original forest. A portage of three-quarters of mile leads south across the height-of-land into Big Rock lake, whic drains into Lake Superior. Obakamiga is fifty-six feet higher th Big Rock lake. A small winding stream called Gum river flows fro Big Rock lake, and forms the canoe route for eleven miles. Former there were three portages in this distance, one 131 chains long; b recently the stream has been cut out and no portage is required. Th land is generally low, and thickly wooded with fair sized spruce an poplar, but there are considerable areas of sandy soil covered wi Banksian pine, also of small second growth. The lower part of t Gum river is only twenty to thirty feet wide, and very crooke There are large areas of good soil and many sandy terraces alo this part.

The Shabotik river is about a chain wide where the Gum riv enters it, and from this point to Natamasagami lake, a distance fifteen miles, there is only one short portage. From the portage the lake the river is broad, with slow current. The soil is genera good, and there are some large spruce and poplar trees. Natam agami lake is over thirteen miles long, and is surrounded by l rocky hills, some of which are well wooded and others recently bu and bare.

THE KEBINAKAGAMI RIVER.

The Kebinakagami river empties into the Kenogami at Mam wemattawa, near the post of the Hudson's Bay Company, in latitu 50° 25′. In a general way, its course is northwesterly as far as was surveyed. It receives several branches, chiefly from the east, there is only a short distance between it and the Nagagami river the west. At a distance of thirty miles up, the two rivers are onl mile and a half apart. The largest branch, Ridge river, enters one mile from the mouth. For a considerable distance the Kebin agami is two to three chains wide, with slack water except in a places. The clay banks are from ten to thirty feet high. Farther where the dolomite rock comes to the surface, the river is wide

consequently shallow. From the forty-seventh to the sixtieth mile, following the bends in the river, the bed of the river is mostly a flat dolomitic rock. In this distance, the stream is almost a continuous rapid, where it is impossible to pole canoes up and unsafe to run them coming down, on account of the smooth rock, shallow water and numerous boulders. In order to pass the worst places it is necessary to wade and drag canoes up or lower them down slowly. At sixty-two miles up, the first outcrop of gneiss is seen, and here the first portage is made. From this point to the portage across to the Mattawishkwia river, five portages are made to pass rapids and chutes. The first is half a mile long, but all the others are short.

The soil is the usual clay loam, and where drained is of excellent quality, but on the lower part of the river the land is so flat that there is little drainage, and muskeg prevails away from the banks. This continues up to the gneissic rocks, where the land is higher and the soil drier, though there are considerable areas of swamp. For twenty miles up the river the country was overrun by fire in 1901, and except small clumps of green woods in places along the stream, there is nothing standing except the bare trunks of trees, the country presenting a most desolate appearance. South of this burnt area, a second growth—probably fifty years old—covers the ground up to the first portage, and above this a recent fire has swept everything bare for three or four miles. Then follows green woods of small growth as far as the river has been examined.

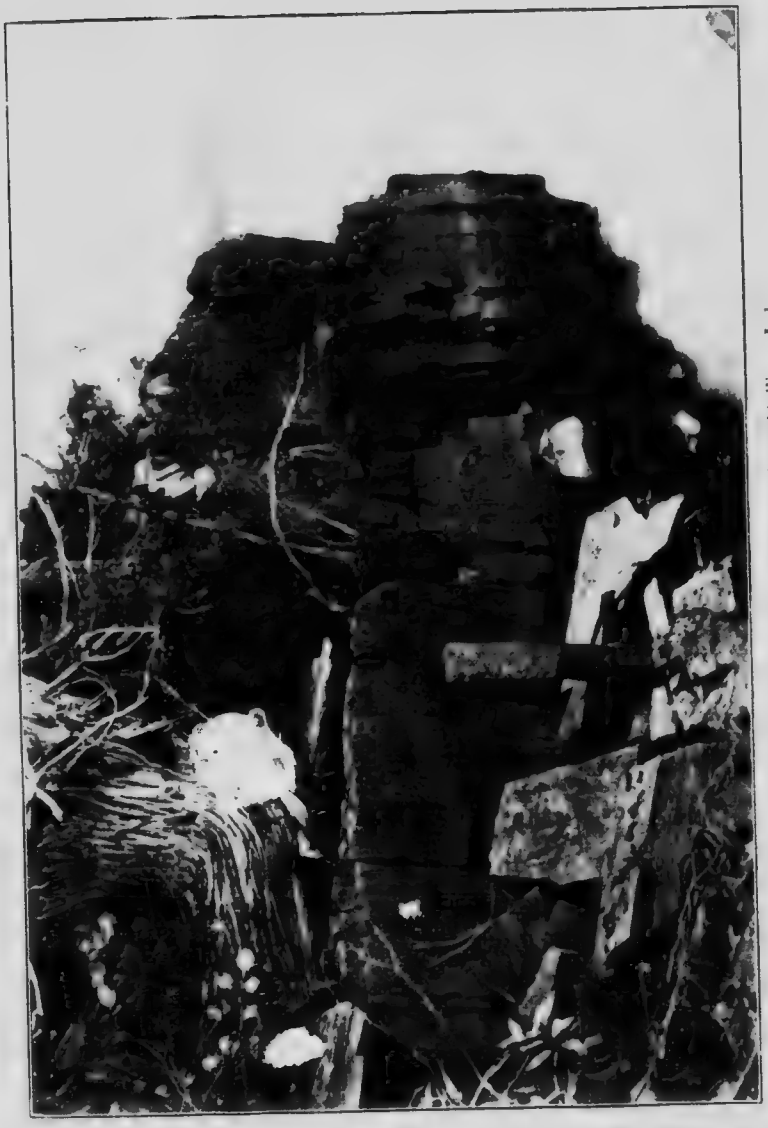
RIDGE RIVER.

A rough track survey was made of Ridge river, which enters the Kebinakagami one mile from its mouth. Its general course is west, and it resembles very closely the lower part of the other rivers examined in this region. It varies in width from two to three chains, and has numerous rapids blocked with boulders. No rock exposures were seen, the banks being till and clay, containing marine shells. The water was so shallow that it was found impossible to take a canoe beyond the forks. At this point the river divides about equally, the south branch extending a long distance up to a lake. This lake can be reached by canoes in high water. The other branch flows from the northeast and is not so long. The whole country drained by this river was burned, as far up as the forks, by the fire of 1901, and only a few green trees are left.

DESCRIPTION OF ROCK EXPOSURES.

THE LITTLE CURRENT AND KAWASHKAGAMA RIVERS.

A reddish granite-gneiss and mica diorite-gneiss striking N. 40° E. appear in occasional outcrops for five miles below the Wawong Lake portage. At the rapid just above Rupert fall there is a pyritous, hornblende schist, dipping S. 40° E.<70°. The contact between the gneiss and schist was not seen, as the country is drift covered, and about six miles separate the two nearest exposures along the river. Between Rupert and Howard falls there are numerous exposures of hornblende and chloritic hornblende schist, the colour varying from dark to light green. At the point where the river turns to the northwest there are outcrops which contain numerous stringers and veins of quartz, some of which are 12″ wide. There are also irregular masses of quartz mixed through the rock. At Howard fall the schist strikes east and west, and is either vertical or dips south at a high angle. All these schists contain much disseminated pyrite. At the fall there are numerous quartz veins and lenticular masses, in one of which ilmenite in small quantity is found. One mile farther down, a rock similar to that at Howard fall outcrops, dipping S. < 80°, and also at the next short portage where it is vertical, and strikes N. 80° E. Numerous granite boulders occur in the river below this portage. In going west from the inlet along the south shore of Abamisagi lake the first rock seen is a coarse grained biotite-hornblende granite. Farther west a fine grained biotite-muscovite granite is seen. This rock is frequently cut by wide dikes of coarse pegmatite. Exposures of granite of varying texture occur along the south shore to the west end of the lake, where they form low rounded hills. Rocky cliffs were seen at the mouth of the northeast bay, but were not examined closely. On the first portage below the lake there is a knob of gneissoid granite. At the second portage the rock is finely laminated, and is a biotite schist dipping N. 35° W. < 50°. It contains masses of rusty quartz. At a small rapid above the last portage before reaching O'Sullivan lake there is a fine grained schist dipping N. 60° W. < 70°. This rock breaks off into broad thin slabs. At the last portage there is an actinolite schist. The hand specimen has a grey, slightly green colour, and appears to be composed of numerous dark green grains and prism-like individuals of actinolite separated by a lighter



Huronian Rock; 3 miles northeast of inlet, O'Sullivan Lake.

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coloured material. Under the microscope the rock is seen to be composed almost altogether of actinolite in broad plates and fibrous aggregates.

O'SULLIVAN LAKE.

Fine grained, biotite schists occupy the northeast shore of the lake, except a small area just below the narrows, where there is an exposure of coarse grey granite. The schists strike from N. 60° E. to N. 80° E., and are usually vertical, and may belong to the Huronian group.

In following the southeast shore, in the first deep bay east of the inlet there is a massive diorite, which, in places, shows a gradation from fine grained to coarsely crystalline. In the eastern part of the lake, a grey-quartz diorite and an epidote granite are mixed with the schists. On a small island three miles southeast from the inlet, there is a band of sericite schist eight feet wide, striking N. 78°. E. and vertical. Lying on the west side of this band there are about twelve inches of ochreous powder containing masses of bluish quartz mixed with the sericite schist. The surrounding rock on the island is finely schistose, and of a dark grey colour. All three of the hand specimens brought from these bands effervesce somewhat freely when touched with dilute hydrochloric acid. A similar band of sericite schist occurs on another island about a mile and a half farther north. Several exposures of diabase and fine grained greenstone occur on the northeast shore and adjacent islands. About three miles from the foot of the lake on the west side there is an outcrop of coarse muscovite gneiss containing small garnets. North of this to the end of the lake, and for some distance down the river, there are exposures of hornblende and biotite schists, followed by granite and gneiss.

For some distance below O'Sullivan lake the hornblende schist, biotite gneiss and granite are intermixed, but as the river is descended, and before Percy lake is reached, a rusty weathering, garnetiferous gneiss, interfoliated with diorite gneiss, and in places with finely banded syenite gneiss and biotite schist, is the prevailing rock, and is seen in frequent exposures. The biotite schist sometimes forms a considerable portion of the rock. These rocks are generally well foliated; they strike nearly east and west, and dip northward at an angle of from 30° to 50°. In going down the river the last large exposure of these rocks is seen at the eighty-ninth mile from the mouth, where a grey granite gneiss outcrops, dipping N. 15° W. $< 65°$. This is succeeded by four miles of fossiliferous dolomites,

then a small mass of hornblende granite about ten chains wid crosses the river. Below this for a long distance cream coloure fossiliferous dolomites are the only rocks seen; and these are fo lowed by soft, argillaceous grey and brick-coloured dolomites described on a former page.

ESKEGENAGA LAKE.

Granite and gneiss are the principal rocks seen round Esk genaga lake and on the islands as far as examined. In the south west bay where the portage reaches the lake a massive, dark gre granite is exposed. Besides quartz, which is very abundant, th rock contains plagioclase, orthoclase, microcline, biotite, muscovit and small portions of an iron ore, probably magnetite. Three mil east following the south shore the rock is of much the same compos tion, but finer grained and showing distinct foliation. The strike N. 55° E. Farther east the foliation continues distinct, and bas bands of hornblende schist alternate with quartzose layers. This the general character of the rocks to near the portage at the ea end. On the east shore the rocks are massive and chiefly acidi One small island is composed of diabase. In the northeast bay ne the outlet there are large masses of a beautiful red granit Ordinary grey granite, mostly massive, is seen along the north sho but some of the adjacent islands are chiefly of reddish granite wi epidote filling small fissures. Along the west shore the granites a frequently cut by basic dikes and stringers of quartz.

The rocks on the route between Eskegenaga and Wababimi lakes are chiefly grey finely foliated gneiss and reddish bioti granite gneiss, striking N. 80° W. On the south shore of the we end of Collins lake there is a considerable mass of porphyritic di base.

WABABIMIGA LAKE.

Two exposures of a well foliated, grey gneiss were seen near t middle of the north shore of Wababimiga lake. The lamination fine and regular, the bands being less than $\frac{1}{8}$" thick. The stri is N. 80° E. On Wababimiga river there are several outcrops of dark, grey gneiss. A massive reddish, granitoid gneiss occurs abo a mile from the mouth, and at two miles there is a fall of thirty- feet over a ledge of grey gneiss dipping S. 28° E. $<$ 80°. At t small lake above the fall the dip is S. 40° E. $<$ 45°.

DROWNING RIVER.

There are only a few rock exposures on the shores of Nestabon lake. Six miles from the south end of the upper lake on a point on the northwest shore there is a greyish gneiss finely laminated, striking N. 75° E. This changes into a reddish pegmatite gneiss much contorted and full of inclusions of basic material. This outcrop is cut by a large dike of diabase, which grades from fine grained at the edges to coarsely crystalline at the centre. On a small island, also in the upper lake, near the narrows there is an exposure of a hornblende granitoid gneiss dipping N. < 30°, and a coarse gneiss was seen on both shores of the lower lake striking N. 70° E. vertical. Occasional exposures of gneiss and granite gneiss were noted in going down the river. Near the portage from Wababimiga lake there is a foliated gneiss dipping S. 50° E. < 45°. Four miles farther down there is a coarse gneiss with large crystals of feldspar striking N. 40° E. vertical. For the next ten miles the ordinary grey gneiss is seen in several places, succeeded by outcrops of hornblende schist for two miles. Below this to the fall just above the mouth of the Wababimiga river the rocks are gneiss, in some places becoming granitoid and quartzose. At the fall the rock is much disturbed gneiss cut by a large dike. A specimen brought from this dike is a dark, greenish-black rock composed almost entirely of actinolite in small and large plate-like individuals, sometimes having a breadth of one-half inch.

For ten miles below the Wababimiga there are numerous outcrops of granite and gneiss mixed with bands of hornblende schists and dikes of diorite. The general strike of the gneiss is N. 40° E.; the dip is irregular, but usually at a high angle. In the next five miles massive reddish-grey granite is common, and near the northern margin of the Laurentian rocks there is a hornblende granite of medium grain and dark colour. For over seventy-five miles below this the banks are clay, and no rock exposures were seen. At the forty-second mile from the mouth the fossiliferous cream-coloured flat-lying dolomites are exposed, and these continue for seven miles down the river. From this to within five miles of the mouth the grey and brick-coloured argillaceous dolomites occur at frequent intervals. As on all the adjacent rivers, these rocks carry no fossils.

An altered gneiss dipping N. 20° E. < 20° was seen on the portage out of Nestabon lake, and on Atik lake an even grained, grey gneiss striking east and west occurs. Reddish granite and

granite gneiss are abundant on Kawakanika and Wawong lakes. On the latter there is a well foliated hornblende gneiss dipping S. < 75°.

PAGWACHUAN LAKE AND RIVER.

Two miles from the entrance to the large lake going east along the north shore the first rock is seen. It is a coarse muscovite granite with large crystals of quartz, feldspar and mica. Farther east along the same shore there are exposures of hornblende schist striking N. 70° E. vertical. Opposite, on the south shore there is an outcrop of coarse reddish granite, interbanded with hornblende schist. On the north shore at the entrance to the narrow part of the lake there is a finely laminated, biotite gneiss striking N. 70° E.

On the first small lake east of Pagwachuan lake the rock is a biotite gneiss, and a much decomposed rock of the same material was noted at the same portage. On Kassagiminissewung lake, 'lake full of islands', the rock is a coarse pegmatite granite, and the low surrounding hills seem to be the same. The basic rocks so prominent on the eastern part of Pagwachuan lake are absent. Near the east end of the long portage into the Pagwachuan river there is a muscovite granite gneiss mixed with basic bands. The dip is not distinct, but seems to be S. 30° E. < 80°.

In descending the river from the long portage there are no rock exposures for twelve miles. At this distance a granular biotite granite occurs and below this the next outcrops are at the southern part of the north stretch where the railway trial line crosses. Here the rock is an even grained fairly coarse acid granite composed almost entirely of quartz and feldspar. Under the microscope the feldspar is seen to be orthoclase, microcline and feldspar. There is also a small quantity of muscovite. Besides the granite there are masses of a fine grained biotite granite gneiss. These rocks are broken up and give the country a rough and hilly aspect. At the portage and fall north of the railway line there is a band of hornblende granite gneiss dipping S. 10° W. < 80°, but the dip is irregular. Just below the fall there is a fine grained, reddish-weathering quartzose granite. This rock contains an abundance of quartz and feldspar, orthoclase, microcline, and plagioclase being present, also biotite and apatite. The next exposure of rock in place is seven and a half miles farther down, where a massive grey granite outcrops. Besides the ordinary constituents it contains small quantities of apatite and sphene. Three and a half miles below this the rock

a rather coarse, contorted hornblende gneiss, with large crystals of reddish feldspar. At the end of another mile the rock ranges from an acid granite to a dark hornblende rock mixed coarsely with feldspar and quartz. This exposure contains epidote sometimes in large lenticular masses and sometimes in dikes from 1″ to 2″ broad. The next rock in place is a fine grained quartzose granite like that at the last portage cut by a basic band 10 feet wide. Only two more exposures of the Laurentian were seen on this river. The first is a hornblende granite of medium grain and dark colour, and the last, thirty-two miles from the mouth of the river, is a reddish hornblende gneiss, well foliated and dipping N. 30° W. < 85°. Below this for twenty-three miles following the bends of the river, no rock is seen in place. Then there is an exposure of a dark dolomite containing fragments of shells. From this point to the mouth of the river, a distance of nine miles, there are outcrops of the flat-lying dolomitic rock. There are ochreous-weathering bands succeeded by others of a cream colour, filled with small cavities, and soft earthy layers of olive colour. A list of the fossils collected from these rocks will be found in Mr. J. F. Whiteaves' report.

THE NAGAGAMI RIVER.

At thirty-five miles from the mouth of the Nagagami, the first rock is seen in place in the bed of the river, and a short distance farther up there is a cliff 20 feet high on the west bank. It is a horizontal, grey, argillaceous dolomitic rock, interbanded with bands of a brick colour, and in some places the two colours are intimately mixed, giving the rock a mottled appearance. It contains 27 per cent of magnesium carbonate, and 31 per cent of calcium carbonate. In ascending the river, the rock becomes a purer dolomite of a cream colour, and contains numerous fossils of Silurian age. There are also bands of a dark yellow ochrey character. The last exposure of dolomite is less than a mile and a half below the first portage. The rock here breaks up into angular masses, giving the whole a rubbly appearance. Crinoid stems were the only fossils seen at this point.

Although the exposures of sedimentary and Archæan rocks are only a little over a mile apart the contact was not seen, the country being covered with clay. The first outcrop of the Archæan is seen at the north end of the first portage in ascending the river. It is a reddish-weathering granite gneiss, dipping S. 20° W. < 20°, but the dip and strike are rather indistinct. It contains small veins of

epidote. In going south the rock becomes more massive and coarse grained and is cut by veins of quartz and chloritic rock. At the foot of the second portage the rock is a fine grained hornblende schist with distinct lamination. The strike is N. 85° W., the strata standing almost vertical. This schist continues up to the third portage which is less than half a mile distant. Here the rock closely resembles a conglomerate, but may be an auto-clastic, and strikes nearly east and west. The strata are vertical and vary from ½" to 8" in thickness. The fragments which in places compose the greater part of the rock are mostly granite, and vary in size from mere specks to one foot or more in diameter. This conglomerate-like band is about five chains wide measured across the strike. Dr. Young thus describes a specimen containing a fragment. 'The hand specimen is of a very fine grained dark greenish rock, closely resembling some of the fine grained hornblende schists. The specimen contains an elongated oval fragment of a coarse biotite granite, and a very long, oval fragment of a rock closely resembling the body rock.'

'Under the microscope this rock is seen to be a very fine granular aggregate of quartz and green hornblende with many slender prisms of the hornblende irregularly distributed through the ground. Except for the presence of the scattered larger hornblende prisms, the rock is of the same nature as some of the hornblende schists. The embedded granite fragment probably represents a portion of a broken dike or vein.'

Hornblende schist adjoins the conglomerate-like band and extends up the river about four and a half miles, and is succeeded by coarse muscovite granite. Grey granite and gneiss, with bands of mica gneiss and hornblende schists dipping S. 30° < 15° are seen at frequent intervals up to Highwood portage. At the mouth of Nagagamisis river the dip is S. < 55°.

In the river a short distance below the south end of Highwood portage, there is a reddish feldspar rock with small grains of quartz, also a much decomposed biotite syenite. The latter rock is of medium grain and has a green colour mottled with pink from the presence of feldspar of this shade. At a short portage above Highwood there is an exposure of biotite gneiss with coarse, [illegible] bands. The dip is N. 20° E. < 80°. Similar exposures are seen up to Highrock portage where there is a biotite gneiss, much contorted in places, and dipping N. 5° E. < 80°, and interbanded with pegmatite masses. Granitoid gneiss is common up to Roughrock portage. Here a number of dikes cut the gneiss which strikes nearly east

west. One dike of diabase is 8 feet wide, and shows the contact clearly. It also shows the gradation from fine grained to coarse crystalline from the edges to the centre. Gneiss and granite are the principal rocks up to Nagagami lake.

At a point about six miles south of Gull Rock portage there is a biotite gneiss which contains a relatively large amount of muscovite in flakes, and cordierite occurs in the same section as small rounded, prism-like forms. At Gull Rock portage the rock is a well foliated, biotite gneiss dipping N. 8° W. < 75° to vertical. There is also a fine grained biotite granite. The fall at this rapid is 35 feet. The river is very narrow, and runs between cliffs 10 to 15 feet high. At Speckled Trout portage, a mile farther south, the rock is a rusty-weathering mica-gneiss dipping N. < 85° to vertical. This gneiss is also cut by diabase dikes. An occasional outcrop of granite-gneiss and diabase dikes is seen up to the Couchiching rapid where an acid granite holding small garnets crosses the river, and causes a fall of 20 feet. North and south of this granite there are finely laminated, soft biotite schists, which are denuded to the level of the water. No more rock *in situ* was seen up to Nagagami lake, but numerous granite boulders lie in the bed of the river.

NAGAGAMI LAKE.

On Nagagami lake there is an exposure of a very acid granite near the north end, and a much contorted biotite gneiss striking N. 75° E. vertical on the east shore. These were the only rocks seen on the lake.

In ascending the river from the lake the first rock is seen at the Sagi portage where a biotite gneiss dips N. 10° W. < 30°. Between Sagi and Elbow portages ordinary reddish-grey gneiss, and dark biotite gneiss show in the river banks, and a mile below the latter there is a fine-grained, hornblende gneiss which contains abundant hornblende and biotite. On Loop portage there is a rotten granular granite and on Weir portage a rough-weathering quartzose rock occurs. On the lake expansion between Bare and Forget portages ordinary grey gneiss is common striking N. 70° E. vertical. On the east shore a little more than half a mile north of Forget portage there is a 'pyroxene granite of medium and even grain, and having a light grey, slightly pinkish colour. It is composed of quartz and light pink feldspars, with abundant scales of biotite, and a nearly equally abundant green pyroxene in small grains. As seen under the micro-

scope the pyroxene occurs in quite irregular individuals and is of
pale green colour, being, probably, a diopside. The abundant brow
biotite is present in irregular flakes and scales. The feldspars ar
largely orthoclase and plagioclase in tabular individuals, but con
siderable microcline in irregular forms is also present.' At Canyo
portage the gneiss dips N. 15° W. < 70°.

Grey and pinkish hornblende and biotite, granite and gneiss ar
the common rocks as far as examined along the shores of the easter
part of the lower half of Obakamiga lake. Where the strike could b
distinguished it was nearly east and west. In the upper lake th
rocks are much the same. At one point about half way up the we
shore there is a syenite gneiss which is very poor in coloured consti
tuents, is gneissic in appearance, devoid of quartz, fine grained an
of a white colour, with many tiny flakes of biotite. Several diabas
dikes were noted along this shore. The height-of-land portage is ov
bare granite hills. A specimen which represents the rock fairly we
is described as a hornblende gneiss or foliated granite, of coarse grai
light grey colour and containing much hornblende and but litt
biotite. The foliated appearance is due to the rough parallel arrang
ment of the many irregular grains of hornblende. This specim
contains good crystals of sphene.

Well foliated grey gneiss occurs on the Gum and Shabotik river
On the former, on what was called Wigwam portage, there is
exposure of massive red granite. The rocks as far as examined on t
east shore of Natamasagami lake are granite and biotite gneiss f
a considerable distance from the north end of the lake, but beginni
about seven miles from Montizambert on the Canadian Pacific ra
way, for over three miles south the rocks are hornblende schist, acid
tuff and basic hornblende-porphyrite. This band has been mapped
Keewatin.

THE KEBINAKAGAMI RIVER.

In ascending the Kebinakagami river, the first solid rock is m
with at the twenty-first mile from the mouth, and is the same as t
grey and brick-coloured argillaceous dolomite found on adjac
rivers. This rock is seen in a few exposures for the next twen
miles. South of this there are many outcrops of brownish and ligh
yellow dolomite stained in places with iron and presenting an ochr
appearance. These rocks are fossiliferous, and a list of the foss
collected is appended. The contact between the Palæozoic a
Archæan rocks is between the sixty-first and sixty-second miles.

the latter a mass of well foliated, fine-grained biotite gneiss dipping S. 40° E. < 30°, crosses the river and necessitates the first portage. A specimen from this place was found to contain cordierite. The mineral is rather abundant, and has irregular outlines, the grains often containing small inclusions of feldspar. It is colourless, but shows the characteristic yellow pleochroism in spots and about minute inclusions. A half a mile distant, at the south end of the portage, the dip is S. 20° E. < 70°. At the second portage, one mile south, the rocks and dip are the same as the south end of the first. Then follows a mass of diabase a quarter of a mile wide. Granite and gneiss were seen at short intervals as far as the river was followed. At the fourth portage the rock is a 'syenitic-gneiss having a very distinct foliated structure and composed largely of pink feldspar and green chloritic mica. In the thin section of this rock, the foliated structure is further accentuated by the parallel arrangement of the longer axes of the feldspar grains which are chiefly of orthoclase.' This rock strikes east and west, and is vertical. Nearly all these gneisses are cut by dikes of quartz and feldspar and sometimes these minerals occur in irregular masses.

GLACIAL GEOLOGY.

The region under discussion has been heavily glaciated, and there is abundant evidence to show that the ice moved from the north over the height-of-land. The stossing is distinctly on the north side of exposures; the peculiar arkose boulders referred to in a former report[1] were seen all over the area, and well down the slope to Lake Superior, and pebbles of banded jasper-iron ores are occasionally met with. These rocks are known to occur in place about Hudson bay. Fragments of the fossiliferous dolomite are distributed in the clay and scattered all over the country to the height-of-land and southward. These facts leave no room for doubt as to the direction in which the ice moved. Exposures of well marked striæ are not common, as much of the rock weathers rather easily, and except when under water or recently uncovered the striæ are obliterated. The direction of the striæ as observed at widely different points varies from S. 20° E. to S. 45° W.

The whole country is deeply covered with clay through which the rivers have cut deep, canal-like channels, in places to a depth of 40 or 50 feet. The clay banks frequently show a distinct line of

1 Summary Report, Geological Survey of Canada, 1902, p. 226.

separation about midway up. The lower half is hard and usually stands at a steeper angle than that above, and contains many large and small striated boulders. The upper part shows stratification, and for a considerable distance from the mouths of the rivers holds marine shells, *Saxicava rugosa* being especially abundant, and *Macoma Calcaria* and *Mya arenaria* are also fairly common. On the Nagagami the shells were found about seven miles from the mouth, but above this, although the clay seemed the same, no shells were found. On the Kebinakagami they were seen for twelve miles up. On all this area these shells are small as compared with those found on the Kapiskau river in 1902, and they are slender and easily broken. This clay is evidently the equivalent of the Leda clay of eastern Canada. It differs in appearance in different localities, but is frequently a bluish unctuous clay very similar to the Leda clay of the Ottawa valley and would, like it, be very useful for making bricks, etc.

Along some of the rivers the clay is overlain by a bed of sand and gravel 2 to 3 feet thick, which contains fresh water shells and is, no doubt, of fluviatile origin.

Natural boulder pavements are seen on many of these rivers on the slopes between the water and the steep banks. Flat and rounded boulders are packed like stones in an artificial pavement, and pounded down and to a considerable extent polished and striated by the ice in the river. The striae are always in the direction of the current. In other places deep furrows are ploughed up by boulders driven by ice along the bank. Good examples of this were seen on the Nagagami. Ice action is also seen on the trees where the bark is torn off sometimes 15 feet above the summer level of the water.

In many of the lakes ridges of boulders are piled up along the shore, especially on points. Some of these walls reach a height of six feet or more, and sometimes contain large boulders; they are undoubtedly formed by recent ice action.

Landslides along the rivers are common, but they are usually small and occur only where there are high, sloping banks. One of considerable extent, and which seemed to be an exceptional case was noted on the Kebinakagami river twelve miles from its mouth. At this point the land is level and the bank rises 20 feet above the river. For ten chains along the bank the ground for five chains back has moved forward into the river, completely damming it for a time. The water has gradually cut channels through it, leaving large masses of the clay well exposed.

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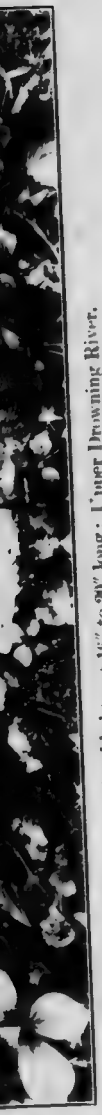

Speckled trout 16" to 20" long: Upper Drowning River.

AGRICULTURAL LAND.

Large areas in the country included in this report are covered by good clay soil, and where the slope is steep enough to afford good drainage the land is of excellent quality for agricultural purposes. The best area lies between the height-of-land plateau and the sedimentary rocks on the Hudson Bay slope. North of this the land is comparatively level and the drainage is not sufficient to carry off the surplus water, so that much of the ground is deeply moss covered.

FLORA AND FAUNA.

As already n[illegible] sp[illegible]e trees up to 2 feet diameter grow along the streams and o[illegible] the drier ground, and poplar up to 15" is not uncommon whe[illegible] conditions are favourable. But the greater part of the area examined is covered with trees of much smaller growth. The most valuable timber commercially is the spruce, which grows abundantly in swamps and averages from 6" to 12" diameter. Usually these trees are high, and carry their size up 40 feet or more. The growth of this tree is slow, and consequently the wood is firmer and more compact, consisting mostly of woody fibre, and therefore particularly well adapted for making pulp. Small ash and elm trees were noted as far north as the mouth of the Little Current, the most northerly point examined, and there is a beautiful grove of elms on the Kenogami river at Mammawemattawa. The presence of these trees shows that the climate is suitable for general agricultural purposes.

The larger animals seem to be rather scarce, as only a few moose, caribou or deer were seen during the two summers spent in the country, and their tracks were not common. The following are hunted for their fur, and are fairly abundant; muskrat, marten, mink, beaver, otter, ermine, fisher, lynx, fox, bear and wolverine.

Fish of various species are abundant in the lakes and rivers and are one of the chief sources of food for the Indians. The fish caught are sturgeon, whitefish, pike, doré, suckers, and speckled and lake trout. Mr. E. E. Vincent, in charge of English River post at Mammawemattawa, informed me that sturgeon are fairly plentiful at that post and are caught up to 6 feet in length, those 4 feet long being common. This post is over 200 miles from James bay. Speckled trout are very plentiful in all the rivers examined, especially the Little Current and Drowning. On the latter, trout from one pound to four and a half pounds were taken with both fly and bait.

APPENDIX I.

NOTES ON SOME FOSSILS FROM THE CAMBRO-SILURIAN AND SILURIAN ROCKS OF THE ALBANY RIVER DRAINAGE SYSTEM IN NORTHWESTERN ONTARIO.

BY

J. F. WHITEAVES.

The fossils referred to in these notes were collected at several localities on the Kebinakagami river by Mr. W. J. Wilson in 1903; on the Little Current and Nagagami rivers by Mr. Wilson and Mr. O'Sullivan in 1903; on the Drowning river by Mr. O'Sullivan in 1903; and on the Pagwachuan river by Mr. Wilson in 1904. All of these streams are tributaries of the Albany.

At most of the exposures examined the number of fossils was small, and often quite insufficient to indicate the exact geological horizon of the rocks from which they were collected. The largest number of fossils or fossiliferous specimens collected at any one locality is about forty. These specimens are from 'Sta. 73' on the Little Current river (forty-one miles from its mouth) and consist of pieces of dolomite, with the weathered surface of each strewn with small fossils, mostly brachiopoda.

The fossils from these five rivers would seem to indicate three geological horizons in the Cambro-Silurian system and one in the Silurian. The genera and species so far recognized in these collections are as follows: these species to which an asterisk is prefixed having been kindly identified by Dr. E. O. Ulrich.

A. FROM ROCKS OF CAMBRO-SILURIAN AGE.

(1) Horizon correlated by Dr. Ulrich with the upper part of the Platteville limestone of the Wisconsin section, which is supposed to correspond approximately with the Black River limestone of the New York section.

FROM LITTLE CURRENT RIVER, STA. 73.

Plantae.

* *Callithamnopsis fruticosa* (Hall).

Arthozoa.

Halysites catenularia, L.

Polyzoa.

* *Holopora*, sp. nov.
'Intermediate between *H. spiniformis* and *H. alternata*.' Ulrich.

Brachiopoda.

* *Rafinesquina*, cfr. *R. Minnesotensis* (Winchell).
* *Strophomena*, sp. nov.
* *Orthis tricenaria*, Conrad.
* *Dinorthis pectinella* (Emmons).
* ? *Dinorthis germana*, Winchell and Schuchert.
* *Leptoena*, cfr. *L. tenuistriata*, Hall.
* *Rhynchotrema Minnesotensis*, Sardeson.

Mollusca.

* *Eotomaria Dryope* (Billings).

Crustacea.

* *Leperditia*, sp. nov.
(2) Horizon probably that of the Galena-Trenton of Manitoba.

Anthozoa.

Streptelasma robustum, Whiteaves.

Little Current river, Sta. 69, thirty-eight miles from its mouth; and Drowning river, No. 122, thirty-six miles and a half from its mouth; one fine and characteristic specimen from each of these localities.

The types of this species, which was first described in 1896, are from the Galena-Trenton at Lower Fort Garry and East Selkirk, Manitoba.

In Appendix IV to the Cruise of the Neptune (1906), Mr. L. M. Lambe writes, that in the collection of fossils made at Southampton island, Hudson bay, *S. robustum* is 'represented by a number of more or less fragmentary specimens.'

(3) Horizon that of the Richmond beds of Ohio and Indiana; the 'Hudson River formation' of the Geology of Canada, 1863, and the 'Lorraine' (D. 4) of Dr. Selwyn (1881), at least in part.

From the Little Current river, Sta. 145, eighty-two miles from its mouth.

Echinodermata.

Crinoidal column, fragment.

'Probably of some species of *Heterocrinus*.' Ulrich.

Brachiopoda.

* *Trematis*, sp. indet.

'Closely allied to *T. punctostriata*, Hall and Whitfield.
One ventral valve.' Ulrich.

* *Rafinesquina alternata* (Conrad).

One imperfect cast of the interior, and two moulds of the exterior, of separate single valves.

Mollusca.

* *Anomalodonta gigantea*, S. A. Miller.

'The small variety which occurs also in the Cincinnati Richmond.' Ulrich.

Eight more or less perfect single valves, and four fragments.

* *Modiolopsis concentricus*, Hall and Whitfield.

'Three specimens of the typical form.' Ulrich.

B. FROM ROCKS OF SILURIAN AGE.

Horizon presumably about that of the Niagara or Guelph formation, of the fossiliferous limestones on the Attawapiskat, Ekwan, Winisk and Fawn rivers.

Anthozoa.

Paloeocyclus, sp. indet.

Drowning river, No. 149, thirty-eight miles and a quarter from its mouth; one well preserved and perfect specimen, but with only the basal surface exposed, showing the concentric markings of the epitheca.

Streptelasma caliculus? Hall.

Pagwachuan river, Sta. 641, five to six miles above its mouth; one imperfect specimen.

Pycnostylus Guelphensis, Whiteaves.

Little Current river, Sta. 67, thirty-seven miles from its mouth; one fragment.

The types of this species are from the Guelph formation of Ontario, but similar specimens have since been collected at Davis point, Lake Manitoba, in 1888, and on the Ekwan river in 1901.

Pycnostylus elegans, Whiteaves.

Little Current river, Sta. 67, one specimen; and Pagwachuan river, Sta. 641, one specimen, which forms the nucleus of the coenosteum of a specimen of *Actinostroma tenuifilatum*, Parks.

The types of *P. elegans* are also from the Guelph formation of Ontario; but specimens of apparently the same species have since been collected on the Ekwan river (in 1901) and on Southampton island, Hudson bay (in 1904). In regard to the specimens from the last mentioned locality, Mr. Lambe writes as follows: 'An interesting feature of these specimens is the preservation of the free edges of the septa, which are seen to be denticulated; about seven denticles occurring in a space of 2 mm. A re-examination of the type material reveals the presence of these denticles, although they are poorly preserved.' (Cruise of the Neptune, p. 326.) The specimens from the Pagwachuan river show that the summit of each of the septal ridges is armed with a longitudinal row of short, slender spines, like the septal spinules of *Aphyllastylus* and of some of the Silurian species of Favosites.

Cyathophyllum, sp. indet.

Nagagami river Sta. 103, thirty-eight miles from its mouth; an imperfect specimen of a large and nearly straight simple species.

Drowning river, No. 132, thirty-eight miles from its mouth; one specimen of a small species apparently allied to *C. articulatum*, Wahlenberg, but which shows very little of the internal structure.

Cystiphyllum, sp. indet.

Drowning river, No. 145, thirty-eight miles and a half from its mouth; a fragment of the corallum of a large and simple species.

Favosites Gothlandicus (Lamarck), Lambe.

Drowning river, No. 173, fifty-one miles from its mouth; one well preserved specimen, showing both the spiniform septa, and the mural pores on the *sides* of the corallites, not in or near their angles, as inadvertently stated of a specimen of *F. Gothlandicus* from the Attawapiskat river in Geological Survey, Canada, 'Palæozoic Fossils,' Vol. III, p. 244.

Little Current river, Sta. 69, thirty-eight miles from its mouth; one well preserved specimen, with the tabuloe densely crowded.

Pagwachuan river, five to six miles from its mouth; a small but characteristic fragment.

This is the *F. Gothlandicus* as restricted and re-defined by Mr. Lambe in the first part of his 'Revision of the Genera and Species of Canadian Palæozoic Corals,' published in 1889, in 'Contributions to Canadian Palæontology,' Vol. IV, part 1. Since that date, specimens of this species have been collected from the Silurian rocks of the Attawapiskat, Ekwan and Winisk rivers, and at Southampton island.

Halysites catenularia, L.

Kebinakagami river, Sta. 188, fifty-nine miles from its mouth; one specimen.

Drowning river, No. 131, thirty-eight miles from its mouth, one specimen; and No. 173, fifty miles from its mouth, one specimen.

Little Current river, Sta. 67, thirty-seven miles from its mouth, one specimen; and Sta. 73, forty-one miles from its mouth, one specimen.

Pagwachuan river, five to six miles from its mouth; several well preserved and characteristic fragments of colonies.

Mr. Lambe thinks that the specimens from these localities are probably referable to the typical form of the species. Of late years, similar specimens have been collected from the Silurian rocks of the Ekwan river, and at Southampton island.

Hydrozoa.

The Stromatoporoidea collected by Messrs. Wilson and O'Sullivan have been studied by Dr. W. A. Parks, of the University of Toronto, to whom they were sent for examination. Preliminary notes on the species recognized in these and some other collections, with descriptions of two that we believed to be new, have been published by Dr. Parks in the Ottawa Naturalist for April, 1908, in a paper entitled, 'Notes on Silurian Stromatopotoids from Hudson Bay.' The names proposed for the two new species are *Actinostroma inflectum* and *Stromatopora Wilsoni*, and it is from this paper that the whole of the following determinations are quoted.

Clathrodictyon vesiculosum, Nicholson and Murie.

Little Current river, Sta. 67, thirty-seven miles from its mouth; a specimen that 'presents an epitheca comparable with that of *C. vesiculosum*, and also shows a faint evidence of the typical structure. Its identification is, however, very questionable.' Parks.

Clathrodictyon fastigiatum, Nicholson.

Pagwachuan river, near its mouth; 'a fragment, in all probability referable to this species, was found in association with *Actinostroma tenuifilatum*, and *Stromatopora Carteri*.' Parks.

Actinostroma tenuifilatum, Parks.

Pagwachuan river, Sta. 641, near its mouth; three specimens, which Dr. Parks thinks are 'intermediate between typical *A. tenuifilatum* and typical *A. inflectum*.'

Actinostroma tenuifilatum, Parks.

Little Current river, Sta. 67, thirty-seven miles from its mouth: one specimen.

Pagwachuan river, Sta. 641, near its mouth; six specimens.

'Judging from the number of specimens, this species is by far the most prolific in the region. While fragments only are available, the inference is obvious that the coenosteum is of hemispherical shape, and that it reaches considerable dimensions.' Parks.

Stromatopora constellata, Hall.

Little Current river, Sta. 67; two specimens. These 'appear to be identical with *S. Hudsonica* (Dawson).'

In Dr. Parks' opinion, 'this species is indistinguishable from Hall's type, and therefore his name should have precedence.'

Stromatopora Carteri, Nicholson.

Pagwachuan river, Sta. 641; one specimen.

'In his description of this species Nicholson states that he identifies one specimen from a boulder on Hayes river. There can be little doubt that the present example is also referable to the same species.' Parks.

Stromatopora Wilsoni, Parks.

Pagwachuan river, near its mouth; one specimen.

'This species is founded on one poorly preserved specimen, but one which presents features rendering it impossible to ascribe it to any known species.' Parks.

Stromatopora, cfr. *S. Indianensis*, Parks.

Little Current river, Sta. 67; a 'minute example of a coarse type of true *Stromatopora*' which is 'possibly referable to this species.' Parks.

Stromatopora, sp. indet.

Nagagami river, Sta. 107, one specimen; and Drowning river, thirty-six miles and a half from its mouth, one specimen.

'Encrusting specimens of *Pycnostylus*, and forming potato-like masses, about 6 cm by 4 cm. Surface smooth. Structure very fine and compact, but too much altered to warrant description. Appears to be closer to *S. antiqua*, Nicholson, than to any other species.' Parks.

Brachiopoda.

Atrypa reticularis (L).

Drowning river, No. 1773, fifty milles from its mouth; one good specimen, associated with *Favosites Gothlandicus* and *Halysites catenularia*.

Mollusca.

Actinoceras, sp. indet.

Drowning river, No. 120, thirty-six miles and a half from its mouth; four portions of casts of the interior of large nummuloidal siphuncles, with deep imprints of slightly oblique septa.

Nagagami river, Sta. 108, thirty miles from its mouth; a similar portion of a cast.

Pagwachuan river, five to six miles from its mouth; a portion of a cast of a similar siphuncle.

Ptenoceras [illegible]uicostatum, sp. nov.

Shell rather small, coiled on nearly the same plane, but asymmetrical, slightly twisted, and consisting of little more than one volu-

tion, with a rather narrow, median, umbilical perforation. Outline of transverse section of the coil, almost circular.

Surface marked with numerous, very thin and narrow, straight transverse ribs, which are much narrower than the grooves or spaces between them.

Septa and siphuncle unknown.

Maximum diameter of the only specimen collected, about 6 cm.

Nagagami river, Sta. 108, thirty-eight miles from its mouth; one slightly distorted specimen.

APPENDIX II.

LIST OF INSECTS.

BY

F. FLETCHER.

The following [illegible] determined by Dr. Fletcher, were collected in the district during [illegible]:—

Lepidoptera.

Butterflies—

Papilio machaon, L., var. *aliaska*, Scud. Hudson Bay slope. Forget portage, Nagagami river, 63 miles northward of Montizam-

Vanessa atalanta, L. Mammawematttawa, July 31, 1903; Height-of-land, measured along the canoe routes, latitude 49° 12′ 47″. This capture is of much interest, as this locality extends its known range very much to the eastward.

Papilio glaucus, L., var. *turnus*, L. With the above.

Brenthis chariclea, Schn. Gum River portage, June 4, 1903.

Brenthis frigga, Thunb., var *saga*, Kaden. Height-of-land portage, June 5, 1903.

Vanessa huntera, Fab. Nagagami river, Nineteenth portage, June 13, 1903; Height-of-land portage, June 5, 1903.

Vanessa antiopa, L. Nagagami river, June 13, 1903.

Vanessa atalanta, L. Mammawemattawa, July 31, 1903; Height-of-land portage, June 5, 1903.

Vanessa cardui, L. Nagagami river, June 13, 1903.

Polygonia faunus, Edw. Gum River portage, June 4, 1903; two specimens.

Polygonia progne, Cram. Nagagami river, June 13, 1903.

Thorybes pylades, Scudd. Mammawemattawa, June 28, 1903; four specimens.

Phyciodes tharos, Drury. Mammawemattawa, June 28, 1903.

Cyaniris lucia, Kirby. White river, near White lake, June 2, 1903.

Everes amyntula, Bdv. Mammawemattawa, June 28, 1903; two specimens.

Moths—

Euplexia lucipera, L. Mammawemattawa, June 28, 1903.

Cosmia paleacea, Esper. Kebinakagami river, August 2, 1903.

Philereme multivagata, Hulst. Little Current river, July 25, 1903.

Nymphula maculalis, Clem. Little Current river, August 22, 1903.

Euclidea cuspidea, Hon. Mammawemattawa, June 28, 1903.

Nymphula maculalis, Clem. Little Current river, July 22, 1903.

Hymenoptera.

Bombus terricola, Kirby. Kebinakagami river, August 2, 1903.

Diptera.

Eriocera longicornis, Walker. Mammawemattawa, June 21, 1903.

Eriocera longicornis, Walker. Little Current river, August 8, 1903.

Eriocera longicornis, Walker. Nagagami river, June 20, 1903.

Musca domestica, Linne. Little Current river, July 16, 1903.

Scatophaga furcata, Say. Nagagami river, Eleventh portage, June 10, 1903.

Scatophaga furcata, Say. Mammawemattawa river, June 21, 1903.

Eristalis transversus, Wied. Little Current river, July 16, 1903.

Atherix variegata, Wak. Mammawemattawa, June 21, 1903.

Dilophus breviceps, Loew. Mammawemattawa, June 21, 1903.

Calliphora erythrocephala, Meigen. Nagagami river, Twentieth portage, June 14, 1903.

Tabanus zonalis, Kirby. Mammawemattawa, June 21, 1903.

Tabanus rhombicus, O. S. Mammawemattawa, June 21 1903.

Tabanus vivax, O. S. Little Current river, July 22, 1903.

Anopheles punctipennis, Say. Kebinakagami river, August 2, 1903.

Hemiptera.

Stenodema instabilis, Uhler. (Family Capsidae.) Mammawemattawa, June 21, 1903.

Salda ligata, Say. (Family Saldidae.) Little Current river, July 11, 1903.

Coleoptera.

Dichelonycha subvittata, L. Nagagami river, Twentieth portage, June 14, 1903.

Syneta carinata, Mann. Nagagami river, June 8, 1903.

Podabrus tomentosus, S. Nagagami river, June 22, 1903.

Donacia subtilis, K. Little Current river, July 16, 1903.

Acmæops proteus, Kirby. Little Current river, July 2, 1903.

Odonata.

Boyeria grafiana, Williamson. Nagagami river, August 31, 1903.

Boyeria vinosa, Say. Kenogami river, July 16, 1904.

Calopteryx aequalis, Say. Nagagami river, July 27, 1903; September 2, 1903.

Aracnida.

Epeira silvatica, Em. Kebinakagami river, August 11, 1903.

Epeira patagiata, Clerck. Mammawemattawa river, June 21, 1903.

Gnaphosa conspersa, Th. Nagagami river, June 15, 1903.

Amaurobius bennetti, Blk. Nagagami river, June 6, 1903.

Tetragnatha extensa, L. Little Current river, July 16, 1903.

Lycosa pratensis, Emer. Kebinakagami river, August 11, 1903.

Lycosa kochi, Keys. Kenogami river, July 2, 1903.

Agræca pratensis, Emer. Kebinakagami river, August 9, 1903.

Agalena nævia, Htz. Little Current river, July 17, 1903.

Neuroptera.

Isoge[illegible] frontalis, Newm. Nagagami river, June 16, 1903.

Isope[illegible] bilineata, Say. Little Current river, July 16, 1903.

Isoperla decolorata, Walk. Kebinakagami river, August 9, 1903.

Nemoura perfecta, Walk. Little Current river, July 20, 1903.

Capnia vernalis, Newp. Mammawemattawa river, June 21, 1903.

Glyphotælius hostilis, Hag. Kebinakagami river, August 11, 1903.

Pycnopsyche similis, Bks. Kebinakagami river, August 11, 1903.

Brachycentrus incanus, Hag. Nagagami river, Sta. 52, June 23, 1903.

Hydropsyche cockerelli, Bks. Nagagami river, June 6, 1903.

The identification of the above Spiders and Neuroptera has been kindly made by Mr. Nathan Banks, of Washington, through the courtesy of Dr. Howard. Although the lists are small they are of considerable interest, being the first lists from this region.

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REPORT

ON THE

REGION LYING NORTH OF LAKE SUPERIOR

BETWEEN THE

PIC AND NIPIGON RIVERS, ONTARIO

BY

W. H. COLLINS

OTTAWA
PRINTED BY C. H. PARMELEE, PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1909

828—4½

No. 1081

To R. W. Brock,

Director Geological Survey,

Department of Mines.

Sir,—I beg to submit the following report upon work done during the field season of 1905 in the region lying north of Lake Superior, and between the Pic and Nipigon rivers, Ontario.

I have the honour to be, Sir,

Your obedient servant,

(Signed) W. H. COLLINS.

May 17, 1906.

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REPORT

ON THE

REGION LYING TO THE NORTH OF LAKE SUPERIOR

BETWEEN THE

PIC AND NIPIGON RIVERS, ONT.

BY

W. H. COLLINS

This region was explored during the fall season of 1905 for the purpose of obtaining information regarding its topography and general geological character. Attention was limited to an area extending from the Pic river westward as far as the Jackpine, and northward from Lake Superior to the height-of-land. This is part of the great region of crystalline rocks commonly termed the Archæan peneplain. Access was obtained by canoe travel along all the navigable rivers and principal lakes; in places where this method was impracticable overland trips on foot were made.

TOPOGRAPHY.

On its southern front, along Lake Superior, the country rises abruptly 200 or 300 feet, but thence northward the general slope is comparatively gentle. The actual surface, however, forms a continuous succession of rounded hills of crystalline rocks seldom exceeding 200 feet in relief. In places this undulatory character is interrupted by vertical cliffs and troughlike gorges, often occupied by streams or lakes. In fact all the larger lakes seem to occupy basins of this nature. Though ranging from six to over fifty miles in length, they are only from a few chains to a mile, rarely two miles wide, presenting a linear appearance when mapped. One or both sides are precipitous, and the general absence of islands indicates considerable depth. These basins show a notable parallelism, which,

together with their peculiarity of form, suggests a series of parallel fault lines or lines of strain that have yielded easily to erosion. Soils, filling the river valleys and depressions, form a thin, discontinuous blanket that ineffectually covers the underlying Archæan floor. They are either glacial in origin, or post-glacial aqueous sediments. All the region has been thickly forested with evergreens, but fires have repeatedly overrun it, producing bare spots or patches of deciduous second growth.

The average elevation of the height-of-land above Lake Superior is about 450 feet, and from the Pic river westward to the Nipigon basin, the southern slope decreases in width from sixty to twenty miles. Consequently all the rivers are short and rapid, becoming progressively more so toward the west. The Pays Plat, Gravel and Jackpine are practically unnavigable during a dry season. All have their sources in the multitude of lakes that lie scattered over the level height-of-land, to drain which they ramify into brooks and creeks. Their upper portions often consist of successions of rock basins, draining from one to another by short rapid stretches, but, on reaching the post-glacial sand and clay beds, they become uniformly shallow, swift and meandering, and are seldom interrupted by falls or rapids.

Little Pic (Pictigonz) River.

At its mouth, two miles east of Middleton, this stream is 100 feet wide, fairly deep, and flows with a good current. In the first four miles up-stream it pursues a direct course between fine hills of red syenite, but, above, the country is flatter, and the river meanders through a low, clay filled valley. In the whole distance travelled it affords easy canoe travel, the descent being accomplished in a number of rapids and cascades, between which the current is light. Twenty portages, the longest of which is thirty-four chains, are necessitated by these obstacles, and by log-jams. The headwaters are said to be a number of lakes lying east of McKay lake. Three tributaries of some size enter on the left, but are either so turbulent or log-choked as to be unnavigable. The uppermost and largest drains Whitefish lake, which is also connected by two portages.

From a creek entering at the north end of this lake, a canoe route, consisting of lakes, creeks and eight well-cut portages, aggregating four miles in length, leads to Rabbit lake on the Pic river. The only body of importance on this route is Kaginogama (Little Long) lake, a narrow sheet twelve and a half miles long, enclosed by steep rocky

shores, and like most of the lakes of the country, almost devoid of aquatic vegetation. From its northern end a broad sluggish creek leads eastward for five miles through low swamp, then turns sharply southward joining the Pic river at the second fall. In its lower part it becomes difficult of travel, and the Pic is reached by two different portage routes.

From a point on the Little Pic west of Whitefish lake a trail leads westward to Steel river, over a level, sandy country, crossing Kawashkimiga and Mizi lakes, headwaters of the Prairie river. At its exit from the latter this stream is only a few inches deep, and in no place navigable for a considerable distance.

Steel River.

Steel river is somewhat smaller than the Little Pic. It is unnavigable for five miles above Lake Superior, flowing torrentially through a narrow valley of steeply tilted eruptive schists. At the head of a series of cascades and rapids, whose total height is 120 feet, lies Mountain lake, a fine oblong body, so named from the bare, rounded hills 250 to 300 feet high that enclose it except at the northern end where the river enters. It is 150 feet above Lake Superior, and is easily reached from the railway by means of a trail cut for the use of tourists.

From Mountain lake up to the fall, a distance of twenty-six miles, the river has cut a tortuous course through finely stratified deposits that fill an ancient rock channel. Current action has worn down and distributed these clays and sands so as to form a uniform bed, whose grade increases gradually up-stream: coincidently, the bed materials increase in coarseness from fine silt to coarse gravel. In no place has the old Archæan floor been laid bare, consequently no rapids or falls interrupt the regularity of slope, and only three short portages are caused by log-jams.

The stratified deposits terminate at the fall, where the river drops fifty-five feet over a ledge of gneiss. Beyond this point are glacial materials, and the river assumes a different character, consisting of a chain of tranquil expansions connected by short rapid stretches. Eighteen miles above the fall the main stream turns abruptly southwest for a half mile to its source, Steel lake, while a branch continuing northward drains others of the chain that extends up to McKay lake.

Steel lake is typical of the linear group that characterizes the

region. It is twenty-one and a half miles long, seldom over forty chains wide, and contains few islands. The shores are of bare rock, the west side being low and well glaciated, while the opposite shore is high and precipitous. A short creek of navigable size entering the south end empties Trout lake, another narrow body, eleven miles in length, that occupies a continuation of the trough containing Steel lake. A canoe route leads from the southeast corner of Trout lake to Mountain lake, following a creek that begins as a rivulet within a quarter of a mile of Mountain lake, but 250 feet above it. The source of Steel river is thus a mere stone's throw from its lower waters, and only seven miles from Lake Superior.

Black River.

Black river empties one-half mile west of Black River siding. In the first mile the ascent is 130 feet, the river dropping about ninety feet perpendicularly into a canyon-like gorge through which it boils for the remaining distance. For eighteen miles above the fall it is similar to the Steel in character, and too shallow in dry weather for large canoes. At Aguasabon lake the main stream turns northwestward, draining the country south and west of Long lake. It is reported torrential and unfit for travel. A branch drains a chain of small lakes that extend northward to within a short distance of Long lake. The short portions joining these ponds are all small and unnavigable, but good portages have been cut, affording a comparatively easy route to Kenogami. Two other creeks feed Black river; Stinking river which rises in small lakes north and east of Schreiber, and Owl creek emptying Owl lake and smaller ponds to the north. Both are navigable in small canoes.

Pays Plat River.

Though broad and deep where it enters Lake Superior the Pays Plat river, a short distance up-stream, dwindles to a smaller size than any of the preceding streams and in midsummer is almost dry. Considered as a means of travel it is a chain of lakes and portages. Four portages, aggregating 200 chains in length, have to be made before reaching Pays Plat lake, and after that the river is scarcely used, portages following the streams connecting the successive ponds and lakes. At Sand lake, the river divides into three creeks, which drain various small lakes north and east. Just to the north of Greenbush lake, the largest of the Pays Plat system, lie Dickison and

Kawesakwagama, narrow bodies that form the headwaters of a large creek flowing into Long lake. These, while possessing the linear form of lakes to the east, are shallower and full of islands and bays as if intermediate in character between lakes like Kenogami and Nipigon. From a long bay on the north side of Kawesakwagama a canoe route leads to Wintering lake. The creek flowing into Long lake is navigable for only a short distance below Kawesakwagama, but portages continue to Kenogami. Caribou creek, the most easterly of the Sand Lake affluents, rises just north of the Zenith mine, and drains small lakes that can be travelled to Greenbush lake.

Whitesand Brook.

This is a brook, quite unnavigable, that drains a great number of lakelets lying north and west of Schreiber. A chain of thirteen of these has been utilized for communication between the Zenith mine and the Canadian Pacific railway, serving as a canoe route in summer and a sleigh road in winter over which the zinc blende is hauled to Winston siding.

Gravel River.

Gravel river is very little smaller than the Steel, but, owing to the uniformity and consequent steepness of its slope, is a difficult canoe route. With the exception of one fall of about twenty feet over exposed gneiss, the bed is evenly graded and lies in well stratified clays and sands. It is very crooked. Above the first forks, where it divides into two nearly equal streams, canoeing is scarcely practicable owing to the shallowness and frequency of log-jams. One branch drains Kabamichigama lake; the other rises in lakes to the northeast and passes within a short distance of Greenbush lake.

At the mouth of Gravel river a tongue-like delta of sand, extending over a mile into Lake Superior, has been built up from material washed down by the current. Several old channels traverse this spit, but during the construction of the railway, the river was deflected toward the west, where it now empties.

Jackpine River.

When seen in August, this river was low enough to permit of walking dryshod over its boulders for five miles up from the mouth. Beyond that it is a shallow creek of moderate current, sometimes travelled by Nipigon Indians. As far as explored it occupies a

canyon-like gorge, averaging 400 feet in depth and from a quarter to a half mile wide. Inland, these walls diverge and become lower.

In addition to the above are a number of smaller streams entering Lake Superior which are too small for travelling, viz., Mink creek, near Port Coldwell; Blackbird creek, entering the head of Jackfish bay; Little Gravel, a half mile west of the Gravel; Cypress, near Gurney.

PRE-CAMBRIAN GEOLOGY.

The entire region is composed of Archæan rocks, all of which are crystalline except in the west where comparatively unaltered sediments may be seen. Good exposures occur almost everywhere, but distinct boundaries are uncommon, and owing to the complexity of folding and intermingling, it was not possible in the time spent to arrive at any definite opinion regarding the thicknesses and relative positions of the various bands. In the neighbourhood of the Little Pic and Steel rivers considerable uniformity of orientation exists, the general strike being northeast and southwest, the dip from 45° to 90°; but from Black river west the structure is highly intricate and inconstant. Dikes and boss-like areas of later igneous rocks portrude through the complex of gneisses and schists.

According to lithological characters, the rocks may be placed in four groups:—

I. Laurentian.
II. Keewatin.
III. Keweenawan.
IV. Eruptives.

The first three names are employed in the sense defined by the Special Committee on the Lake Superior region,[1] except that eruptive bodies whose relationships distinguish them from the usual Laurentian gneisses are grouped separately.

LAURENTIAN.

A major part of the area explored is formed of rocks comparable with the Laurentian of other districts. It comprises an intimate association chiefly of granites and gneisses of various sorts, seldom sharply limited, but passing gradually from one type to another, and frequently so contorted and interfoliated as to produce banded gneisses unlike either original. Granites and gneisses rich in feldspathic materials and seemingly of igneous nature predominate, but

[1]Summary Report, G. S. C., 1904, pp. 18-27.

para-gneisses are also present, as well as forms derived from close intermixture of both types, whose genetic origin is thus two-fold. Prominent types are:—

(a). *Muscovite gneiss.*—On Whitefish lake are whitish feldspathic gneisses containing muscovite and rich in alkaline minerals. Sections consist of allotriomorphic quartz, orthoclase, microcline, plagioclase, muscovite, biotite, and accessory apatite in prisms. The muscovite occurs in irregular plates, and also within the orthoclase as thin scales oriented parallel to the cleavages.

(b). *Hornblende granite and syenite.*—From Jackfish, westward, extends an area of these rocks, whose contact on the north with other Laurentian rocks is extremely vague. In the field they appear grey or red where tending towards syenites. Thin sections show the constituent minerals to be much decomposed and hypidiomorphic. Kaolinized feldspars preponderate, with considerable hornblende and sphene; magnetite and crystals of apatite are also present. Quartz is usually a constituent.

(c). *Hornblende and biotite gneisses.*—These are usually coarse, fresh-looking, and rich in quartz and feldspars. Biotite or hornblende or both are the principal coloured minerals.

(d). *Biotite-garnet gneiss.*—This rock occurs either in fairly well defined bands or grading insensibly into the adjoining igneous gneisses, often being so finely interbanded as to produce intermediate forms. It is a fine speckled, gneissic or schistose rock, composed of fine alternate layers of light and dark minerals, glistening black and white when fresh, but becoming yellowish and friable on weathering. Specimens from various points are very uniform in mineral composition, most sections containing biotite, feldspars, quartz, garnet, apatite, sphene, and often hornblende and pyrite altering to limonite. None of these are idiomorphic. Biotite invariably contains inclusions surrounded by pleochroic halos.

Rocks of this nature have been collected by Mr. W. J. Wilson on the Nagagami, Little Current, and other northern rivers, thus indicating a widespread occurrence. Everywhere they are intimately associated with the Laurentian. They seem identical with the biotite gneisses of Lawson's Couchiching and similar rocks in the Grenville of eastern Ontario. In all likelihood they are of sedimentary origin, perhaps ancient sandstones, and belong naturally to the Keewatin group as now defined, but they are so inseparably associated with

Laurentian rocks that, for purposes of geological mapping, they cannot be separated. For this reason they are arbitrarily mentioned here and not distinguished on the map when lying within a Laurenthian area. Along with certain black, well metamorphosed hornblende schists they seem to form the base of the Keewatin series.

KEEWATIN.

The Keewatin rocks of the region fall naturally into two groups. Extending along Lake Superior is a broken band of compact, dark green, grey or black schists, largely eruptive in nature, and in contact with the Laurentian. About Heron bay and southwest of Long lake are other much older looking rocks, whose petrological characters indicate them to be true para-schists and comparable with rocks of other regions now classed as Keewatin. In appearance, these are quite unlike the eruptive group and are more highly metamorphosed. On the Black river they lie adjacent, but at high angles, and the character of the contact is obscure. The relationship of the older group to the Laurentian is equally indefinite; their contacts are always vague, forming zones several miles in width, in which the two series are scarcely dissociable. The dark eruptive bands on the contrary are sharply defined. Commonly, the present orientation of the Keewatin seems to have been determined by the Laurentian granites wherever adjacent.

The older group contains:—

(a). *Graphitic, garnetiferous gneiss.*—A dull, dark grey rock, distinctly resembling the garnet-biotite gneiss previously described, was obtained north of Lake Aguasabon. It consists of a mosaic of quartz, feldspars, and biotite, with some large grains of garnet, small apatite crystals and ragged patches of graphite. The garnet fragments are colourless, much fractured and corroded by quartz.

(b). *Quartzites and arkoses.*—On Caribou lake are considerable areas of hard white and grey rocks consisting principally of quartz. The structure is mylonitic, quartz often forming the bulk of the sections, but more frequently having mixed with it decomposed feldspar fragments, and a little biotite.

(c). *Amygdaloids.*—These were found on Kawesakwagama lake, Black river, and near Heron bay. When weathered the amygdules stand up, producing a pebbly surface. A. P. Coleman[1] has described

[1] A. P. Coleman, Bur. of Mines, Ont., 1899, p. 167.

these as ophitic rims of plagioclase, magnetite, and hornblende, enclosing amygdules of epidote, zoisite, titanite, and other indeterminable minerals. The amygdaloid bands are all narrow.

(d). *Talcose schists.*—These are greenish, well laminated schists occurring at Heron bay, also on Dickison lake. They appear talcose in the hand specimen and effervesce freely when treated with hydrochloric acid owing to the large proportion of secondary calcite. Thin sections show alternate rude bands or lenticles, the one of a feldspar and quartz mosaic with a few shreds of talc, the other of semi-opaque secondary calcite and talc. Some large idiomorphic crystals of orthoclase suggest an original porphyritic structure.

(e). *Schist conglomerate and agglomerates* are also recorded by Coleman, and the hornblende schists and garnetiferous gneisses mentioned in connexion with the Laurentian above probably belong here. Interesting crystals of tourmaline are often met with in sections of the former, consisting of blue kernels with a brown periphery of characteristic form.

The younger eruptive series consist of sheared porphyries, etc., all containing much secondary chlorite and pyrite. They lie at high angles and strike generally southwest and northeast.

(f). *Chlorite schist.*—Near Mountain lake are well foliated close grained rocks composed largely of secondary materials. A light green pleochroic chlorite, with the polarization tints of pennine, is abundant as shreds lying in the planes of schistosity. Decomposing orthoclase, secondary calcite, quartz and pyrite grains altering to limonite make up the remainder. Epidote veins are common.

(g). *Hornblende schists, orthoclase porphyry with the phenocrysts showing zonary structure, and fine grained black tuffs* are other common types. Some of these schists bear thin layers of magnetite and are probably not eruptive.

KEWEENAWAN.

Rocks of Keweenawan age appear first near Gurney. Most notable are brick red dolomites, with some narrow black and grey layers, lying quite horizontally and unconformably upon the Archæan gneisses. At the bottom is a thin conglomerate formed from pebbles of Archæan materials cemented by dolomite. At their margin near Gurney station only isolated vestiges of these easily eroded beds remain, filling depressions in the older crystalline floor. At the

Jackpine river, where an excellent section is observable, the dolomites are 15 or 20 feet thick and protected by an overlying bed of diabase 300 or more feet thick.

The dolomites are quite amorphous and part into very thin laminæ whose surfaces show distinct ripple marks. Small inclusions of calcite and, less frequently, selenite are common. Analysis shows it to be a somewhat impure dolomite containing arenaceous matter. It seems to represent a shallow water deposit—near an old shore judging from the conglomerate. The black bands appear to contain carbonaceous matter.

Following is an analysis of a sample taken between Gurney and Mazokama, on the Canadian Pacific railway:—

	Per cent.
SiO_2	30·96
Al_2O_3	11·19
Fe_2O_3	
CaO	17·13
MgO	11·36
CO_2 (calculated)	26·84
H_2O (at 100°)	0·55
H_2O (above 100°)	1·64
Total	99·67

The associated diabases have been found farther west,[1] lying intrusively within the sediments, and are regarded as or about the same age. The Keweenawan seen at Gurney forms the southeast boundary of an area in the centre of which lies Lake Nipigon.

ERUPTIVES.

Eruptive rocks of the Lake Superior region are very varied petrologically, and of quite different ages, as evidenced by the manner in which they intersect one another. As most of them are associated with Laurentian and Keewatin areas their absolute times of intrusion cannot be fixed with any precision.

Hornblende and Elæolite syenites.—A bosslike, elliptical area of these rocks extends along the Canadian Pacific railway from near Middleton station (mile post 84) to three miles east of Peninsula (mile 60¾), and north from Lake Superior about four miles. It con-

[1] A. W. G. Wilson, Summary Rep. Geol. Surv., Canada, 1901.

sists of coarse dark red hornblende and augite syenites, grading towards the centre into pale grey hornblende and eleolite syenites marked by long black crystals of hornblende. The latter rocks are composed of alkali feldspar, eleolite now very much decomposed into liebenerite, hornblende in long prisms, biotite, augite, apatite, and a secondary sodiferous mineral. The coloured minerals are intergrown, biotite and hornblende often being in parallel growth. The order of crystallization has been: apatite, pyroxene, hornblende and biotite, feldspar, eleolite. Veins of a white or greyish radiate mineral resembling natrolite in composition and probably derived directly from the surrounding rocks, occur near Coldwell. Near Peninsula, Coleman has[1] found dykes of a rock (heronite) approximating closely to analcite tinguaite. East of Middleton, the basic syenite contains inclusions and dike-like sheets of an older picrite, which graduates into olivine gabbro at other points.

Red syenite like the above was found near the forks of the Gravel river, but the area was not investigated.

Diorite.—A small area of diorite occurs on the Whitesand route, twelve miles north of Winston. The rock is fairly coarse, and rich in hornblende, sometimes approximating to an amphibolite. It contains both brown and blue-green hornblende, the latter fibrous, lime feldspar in laths, sometimes quartz, and commonly in the darker varieties masses of pyrite. The area is less than three miles across. Near its western edge are several irregular ore bodies of black, ferriferous sphalerite.

Pegmatites.—All through the Laurentian are small bosses and dikes of very coarse granites, easily recognized at a distance by their white weathered surfaces. They consist of alkali feldspars and quartz, often graphically intergrown, muscovite usually, and biotite.

Diabases.—Besides the sheets intruded into the dolomites about Lake Nipigon, diabase dikes up to 100 feet wide are common, especially along the Steel river.

DISTRIBUTION.

Following the railway from Heron bay, the first six miles cross an area of Keewatin talc-schists, amygdaloids, etc., dipping steeply toward the north, after which the syenites already described extend to Middleton. This Keewatin area has been found by Dr. Bell to

[1] A. P. Coleman, Bureau of Mines Rep. 1900, p. 186.

extend seven miles up the Pic river. In ascending the Little Pic river from near this station the first four miles are through basic red syenites of this area. Thence up to Rabbit lake, all is Laurentian; biotite and hornblende gneisses and granites predominating. Pegmatite and diabase dikes are less frequent than on the Steel river. Just north of Whitefish lake, a band of biotite-garnet gneiss is crossed. Outcrops of diabase occur on the river south of the same lake. Continuing along the railway to Jackfish, the whole distance is occupied by Keewatin. For a mile or more west of Middleton, the rocks are olivine gabbro, amygdaloids, and schists like those at Heron bay, which, however, pass into fresher looking, dark, steeply tilted eruptives. This area extends up the Steel river to the middle of Mountain lake where it gives place abruptly to hornblende granites. A mile farther north these granites fade imperceptibly into Laurentian, resembling and probably continuous with that seen on the Little Pic. Several broad diabase dikes cross Mountain lake and the river above. Bands of biotite gneiss are common.

The Keewatin schists are interrupted at Jackfish by a granite and syenite mass that the railway traverses nearly to Schreiber. It gives place, however, a mile or so northward, to a second band of dark schists, whose southern edge, beginning at the south end of Trout lake, passes a quarter mile south of the Empress mine, crosses the Black river a mile and a half above the railway bridge, and appears on the railway about mile post 116 east of Schreiber. This belt is seven miles wide where crossed by the Black river, and is followed on the north by the older Keewatin group, consisting here of amygdaloids, quartzites, graphitic-garnetiferous gneiss, etc., which, above Agua-abon lake, gradually mix with and give place to Laurentian granites. The transition on Trout lake is equally indefinite; a wedge-like termination of an altered hornblende schist is followed on the north for about three miles by intermingled, well crystallized hornblende schist, biotite-garnet gneiss and coarse feldspathic gneisses, of which the last mentioned become more and more abundant until, at the foot of the lake a true Laurentian series exists.

Keewatin extends continuously from its eastern contact with the Jackfish granite at mile 116 as far as mile 5 west of Schreiber, except for two small patches of granite, one at mile 117, the other about mile 3, after which granites and gneiss extend uninterruptedly to near mile 36 east of Gurney, and then disappear under Keweenawan dolomites. Granite extends along the Whitesand route for seven

miles, narrow bands of green schists crossing on Lynx and Hornblende lakes. From Boot lake up to Brown Otter lake, just north of Caribou, are Keewatin porphyries, hornblende schists, quartzites, and diorite. A thin band of much altered rock occurs on Bird lake.

The Pays Plat route not far to the west is entirely through Laurentian of the usual character, and no Keewatin is seen below Kawesakwagama, except one thin band of talcose schist that crosses the upper end of Dickison lake. Kawesakwagama lies in green schists, replaced at its outlet by an amygdaloid-like gneiss.

Gravel river crosses the Laurentian area seen on the Pays Plat. Rocks like those on the north end of Kawesakwagama lake begin just above the forks.

From Gurney westward, and on the Jackpine river, are dolomites and diabases. The edge of this area is thin and ragged, the underlying Archean often showing through.

GLACIAL GEOLOGY.

Since the ice period, the general surface of the Lake Superior region has not been notably further denuded, for everywhere the superficial effects of ice action remain visible. Smoothly rounded rocks, grooves and scratches are abundant over the whole area, and alteration of the rocks bearing such marks can be measured in inches or fractions of an inch.

The amount of material eroded during or preceding the glacial period can only be surmised by contrasting the present undulatory surface with the conjectured original covering required to account for the evidences of dynamic activities furnished by the rocks of the region. A small quantity of the eroded materials remains scattered over the present surface. Boulders and till, often containing fossiliferous limestone pebbles, occupy the higher valleys; these are well seen along the Black river. An erratic of magnetite several hundred pounds in weight was noticed near Greenbush lake, and similar ones are reported by Indians. Just south of Kagianogama lake a portage follows the crest of a morainic ridge that extends for somewhat less than a mile in a southerly direction. Glacial striæ noted at different points vary in direction from 179° to 200°.

POST GLACIAL GEOLOGY.

For distances up to twenty-five miles from the present Lake Superior may be found vestiges of stratified sand and other loose

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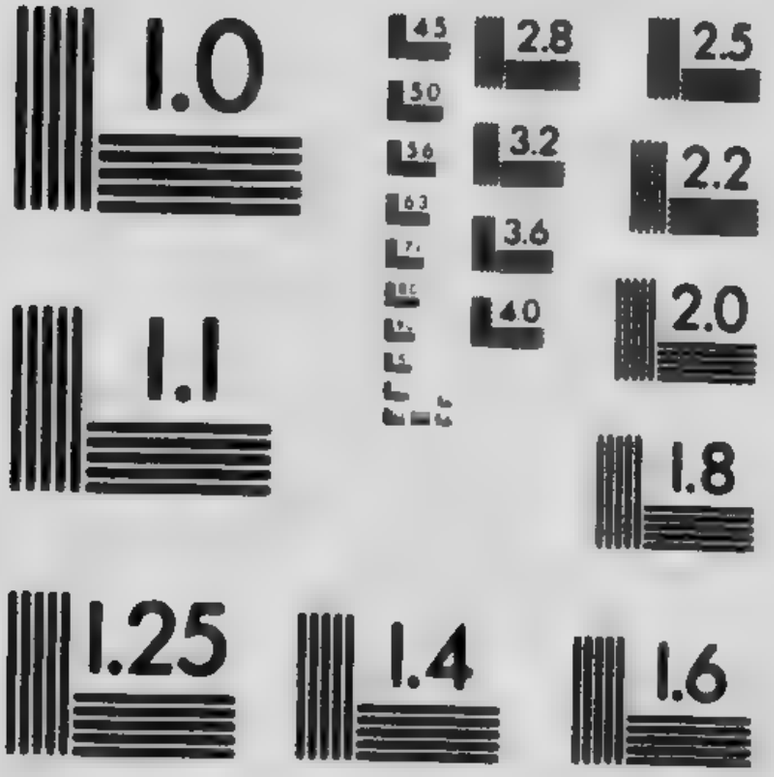
(ANSI and ISO TEST CHART No. 2)



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deposits laid down during or following the ice period. Occasionally these are met inland from the river valleys, but principally in the latter and sometimes along the lake shore. Such deposits occur in the Pic, Black and Gravel valleys, but most perfectly on the Steel river, where they extend from Mountain lake up to the fall and for several miles inland. Near the fall, the forest has been burnt off, and the original surface can be seen from the overlying Archæan hills as a perfectly level floor once filling the entire valley, but now deeply channelled by the river, which in meandering has sometimes carved out flat-topped hills. By barometric measurement the surface lies about 275 feet above present lake level. Where not disturbed by slipping the beds are perfectly horizontal, and consist of fine sands and gravels sometimes cross-bedded. The thin gravel layers are usually fossiliferous, bearing small bivalve and spiral shells. The lowermost 175 feet of the Steel River beds have been carried away, but are well exhibited in the Gravel and Pic valleys as finely laminated, tough clays overlaid by sands.

The loose nature of these beds and the swiftness of the rivers traversing them admit of very rapid removal. The Gravel river is rapidly adding to the sand delta at its mouth, and the vicinities of the mouths of the others are shallow and sandy, in notable contrast to the bare, precipitous character of the coast at other points.

ECONOMIC GEOLOGY.

Minerals of economic importance occur in considerable variety, but, up to the present, few deposits of valuable extent have been found. Mineralization is confined largely to the Keewatin rocks.

These appear to be largely metamorphosed sediments, are varied in character, and during their formation mineralizing agencies have been operative. The operatives are sulphide bearing, principally secondary pyrite and pyrrhotite, which are sometimes concentrated into bodies of considerable size. Such bodies have been located in the belt of younger Keewatin rocks near Lake Superior. Five miles northeast of Rossport are veins and masses of pyrite and pyrrhotite with traces of sphalerite. A similar body has been worked near Schreiber by the Davis Sulphur Ore Company, for the purpose of sulphuric acid manufacture. Pyritiferous quartz veins occur near Rope lake, west of Schreiber, at the Otisse mine, at the Empress and Ursa Major mines north of Jackfish, east of Mountain lake, and other points. Some of these are low grade gold ores and have been

worked for that metal, e.g. the Otisse, Empress, and Ursa Major properties. Quartz veins seem particularly numerous in the talcose and hornblende schist bands, varying from irregular strings to veins 15 feet wide. A small gold nugget belonging to Mr. Dampier of Rossport, is said by him to have been taken from one of these veins on Hornblende lake.

Native copper is found in flakes in amygdaloidal trap on the islands off Rossport, but this formation does not occur on the mainland in the area here described.

Black zinc blende occurs in irregular bodies on the western edge of a diorite area at the Zenith mine. It has been mined for some time, but is now idle and the shafts full of water. The blende is ferriferous and mixed with pyrite near the edges. Three shafts have been sunk and an open-cut made in a neighbouring hillside. A less promising outcrop occurs a couple of miles south, known as the Gezie property. Pyrite outcrops were also observed on the eastern side of the same igneous area.

A vein of impure graphite crosses Caribou lake, and similar appearances were noticed on Rope and Aguasabon lakes.[1]

The Laurentian is essentially igneous in origin, consequently in the process of formation magmatic segregation would be the chief means of mineral concentration, and, being feldspathic and siliceous in constitution, any minerals of value formed therefrom would be non-metallic. The only such mineral noticed was muscovite, and this never in flakes more than 2" across. Near the northern border of the Port Coldwell syenites, which are unusually ferriferous, are masses of titaniferous magnetite probably segregated from it. Secondary mineralization of veins with matter leached from adjacent rocks has been uncommon, the best instance observed being a few fissures near Pays Plat filled with limonite and barite. A small auriferous quartz vein in granite just west of Jackfish is reported by Professor Coleman, but quartz veins in Laurentian rocks are not abundant.

The Keweenawan sediments were not observed over an extensive area, and no minerals of importance seen. The heavy cap of diabase renders it accessible only occasionally.

Sands along all the southern part are magnetite bearing. Considerable amounts were noted on the Steel river, Owl lake, at Peninsula and Rossport.

[1] Thin seams of magnetite were found in hornblende schist a mile northwest of Schreiber, and, on Caribou lake the biotite gneiss is banded in places with the same mineral. Neither of these are in quantities worthy of exploitation.

OTHER RESOURCES.

Forest growth is in all stages of rotation. The oldest areas consist of black spruce, balsam, and tamarack, with a little cedar along the rivers and jackpine on the high ground. The best growths, containing timber up to 15" or 18" diameter, are coincident in distribution with the soils and water, i.e., occupying the depressions and valleys, while the hills are bare of both soil and timber, or only thinly covered. Especially along the south, much of the old forest has been burned off, and replaced by luxuriant growths of berry bushes, followed later by poplar, balm of gilead, and birch second growth, under shelter of which a new crop of evergreens begins and eventually destroys it. Sometimes, yellow birch 18" or 24" in diameter are found in old growth, having survived the struggle with the evergreens. Canoe birch are smaller but more abundant. Much of the best timber has been removed, but considerable jackpine and tamarack are available for ties, and spruce for pulpwood.

For agricultural purposes a very small portion of the country is serviceable. At Pays Plat and Pic reserves, vegetables are successfully cultivated, and timothy grows luxuriantly where accidentally sown about mining and lumbering camps.

Good water-power can be obtained near the railway on the Steel and Black rivers. On the latter, a sheer fall of about 90 feet occurs within a very short distance of both the railway and Lake Superior.

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GEOLOGICAL SURVEY

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Department of Mines

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1907

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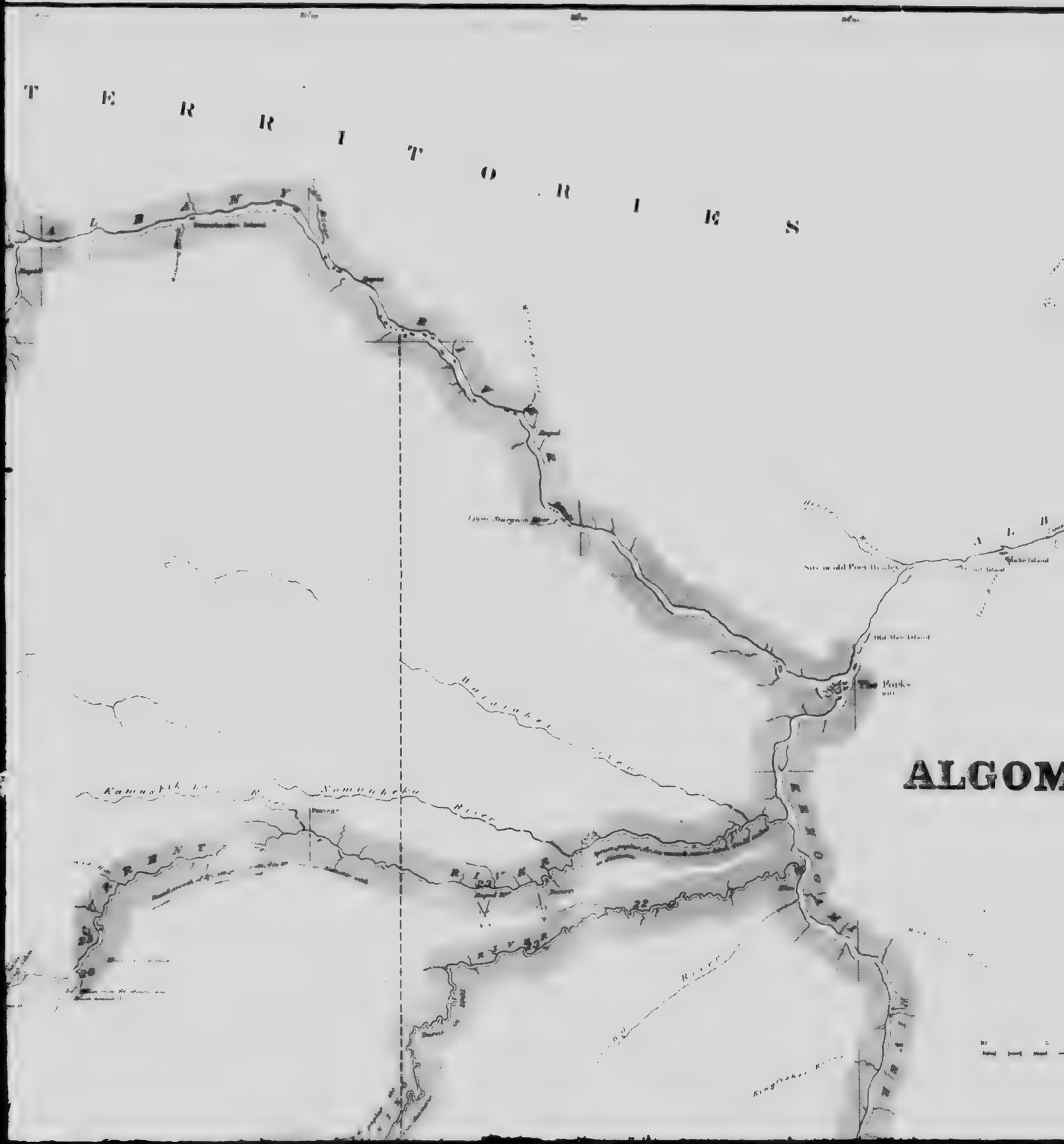

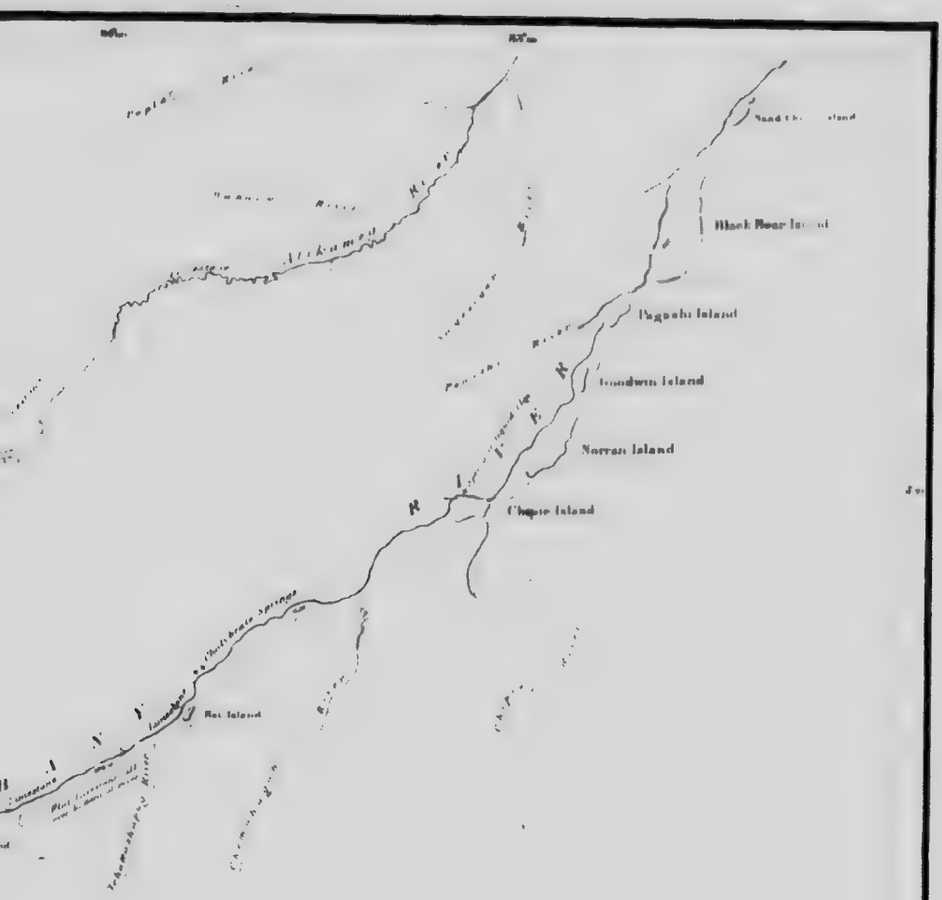

GEOLOGICAL MAP

of portions of the Districts of

MA and THUNDER BAY

ONTARIO

To illustrate Reports by
W.J.WILSON, Ph.B., and W.H.COLLINS, B.A.,
1903 5.

Scale 8 statute miles to 1 inch

SOURCES OF INFORMATION

Astronomically checked micrometer surveys of Little Current river and the canoe route from Manitowaning L. P.Ry to Mamamawmittawa via the Naiscoutaing river by W.J.Wilson and OO'Sullivan 1903. Micrometer surveys of Pagwachuan, Vermilion and Shrubish rivers and the lower portion of Kebinakwagami river by W.J.Wilson 1902 1903. Micrometer re-surveys of Little Pic river and canoe route to Hudson Lake Steel, Black, Playa Flat and Gravel rivers by W.H.Collins 1902. Astronomically checked traverse survey of Brunswick river by OO'Sullivan, 1901.

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Surveys of Canadian Pacific Railway ... 1870-71.

Transit chain surveys of Gravel, Jackfish, Peninsula and Nipigon Branches of Canadian Pacific Railway, 1901-02.

Supplementary information by R.Bell 1870, 1880 and Ontario Crown Lands Department.

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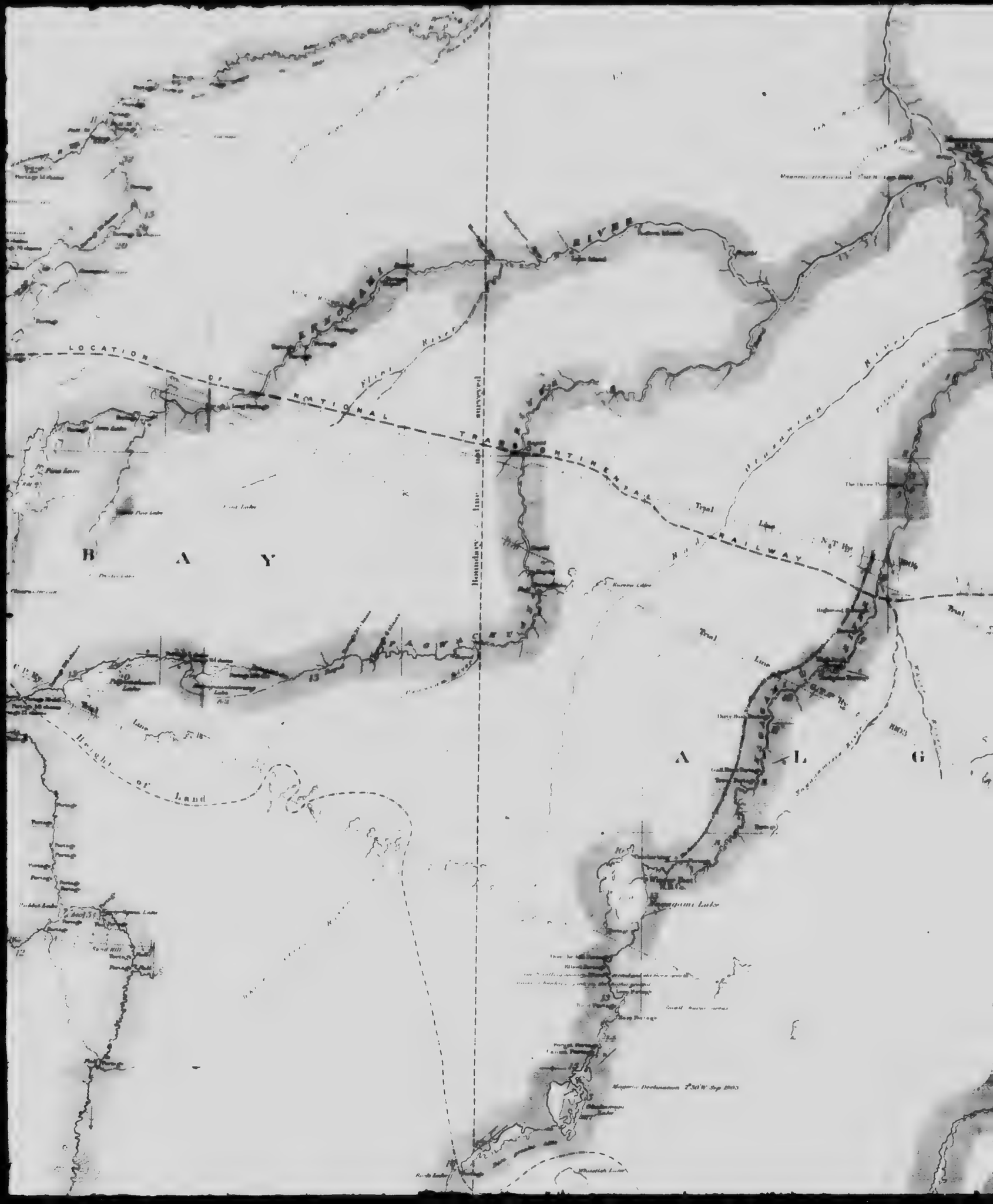
LAKE
NIPIGON
THUNDER
Hudson Bay
Height of Land
Huenboldt Bay
East Bay
Trail
N T Ry
Flat I
Red Willow I
Poplar Point
Hat Mountain
Cedar Island
Alexandra
Lone I
Columbus Point
Cooke Point
Lake Nipigon
Portage
Lake
Trail
Winterday Lake
Pipe Flat Lake
Cross route to Kinmanay Lake
1877
1863
1865
1867
1862
Indian
Reserve
Indian
Reserve


APPROXIMATE LOCATION OF NATIONAL TRANSCONTINENTAL RAILWAY
Boundary line surveyed
Height of Land
Flint Lake
Flint River
Gamebre's
Lake Superior


LOCATION
OF
NATIONAL
TRANSCONTINENTAL
RAILWAY
Height of Land
Boundary line
Trail
Lake
Lake Superior
Lake Nipigon
Nipigon River
Kaministiquia River
Pigeon River
Rainy River
Lake of the Woods
Winnipeg River
Whitefish Lake
Sturgeon Lake
Dog Lake
Shebandowan Lake
Kashabowie
Port Arthur
Fort William
Rainy Lake
Fort Frances
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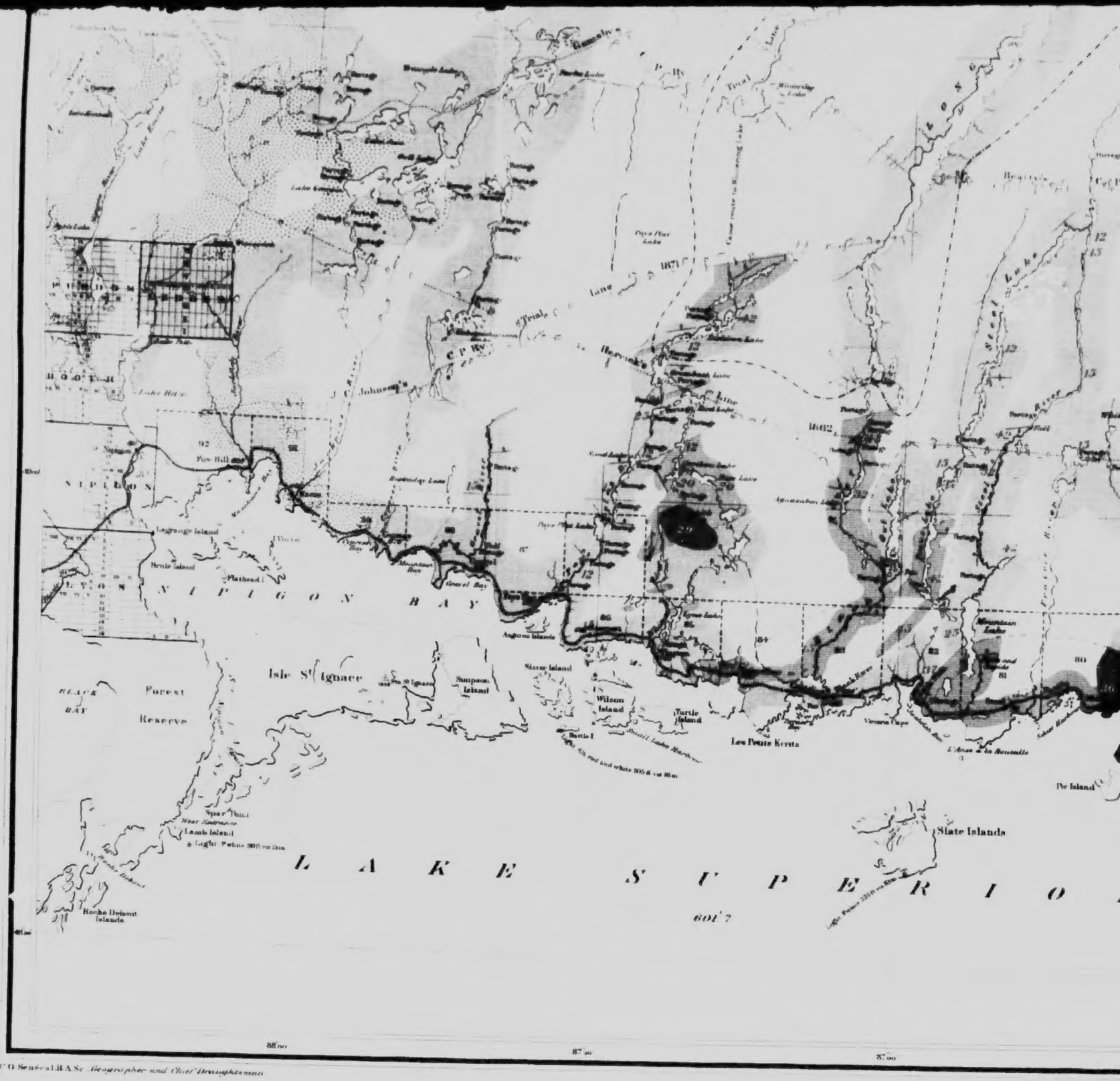
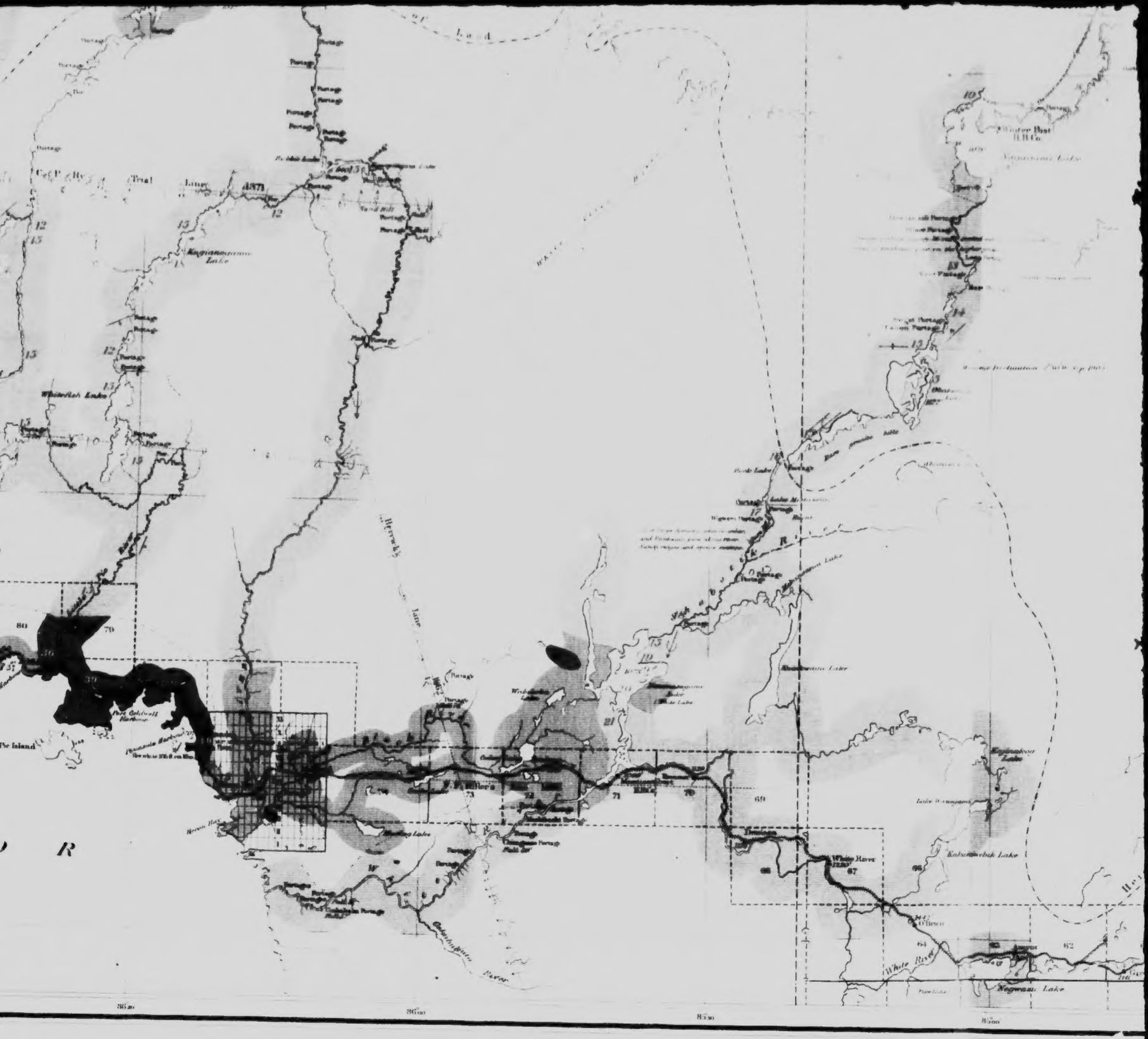
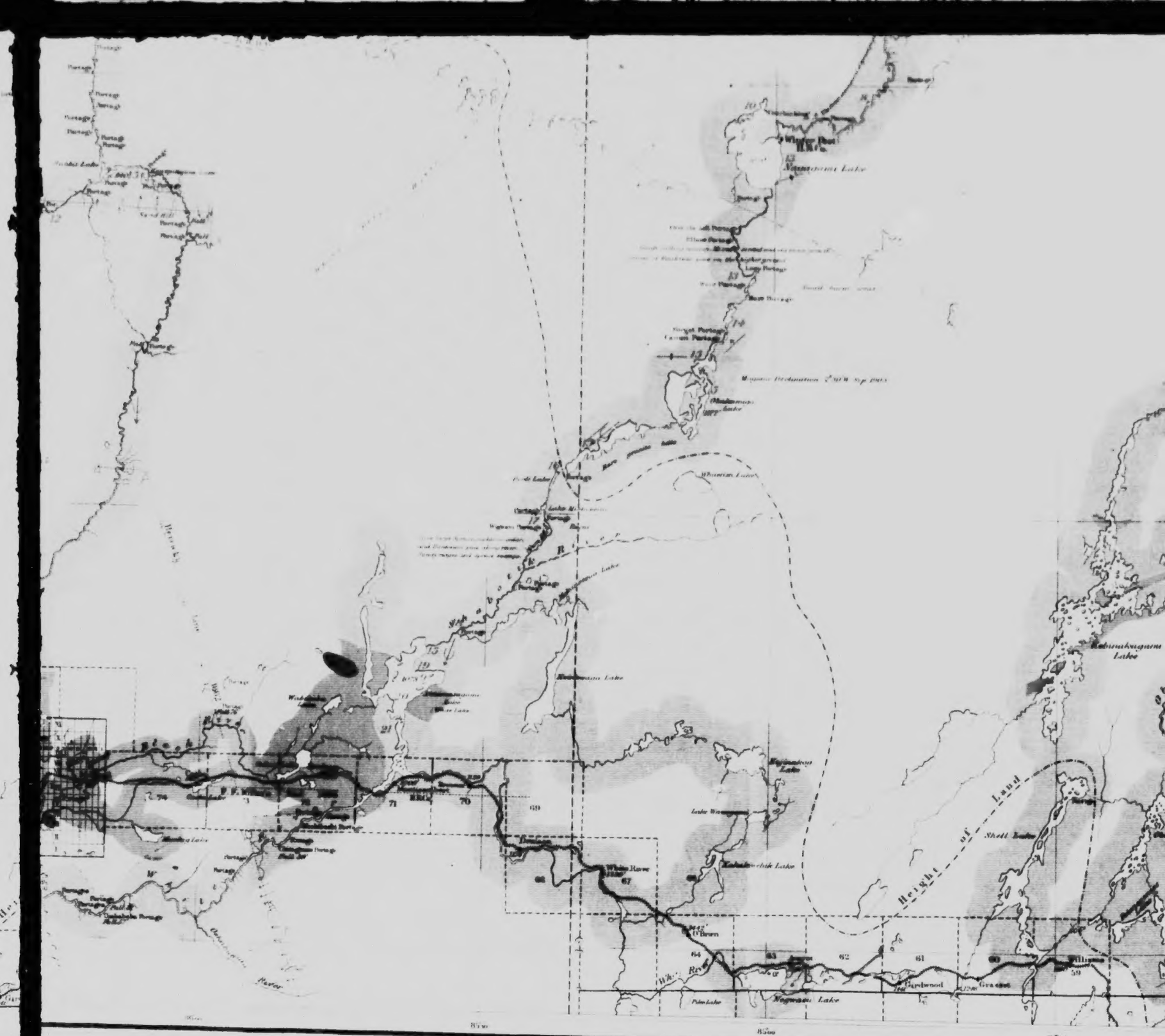
Keewatin
Ontario
Manitoba

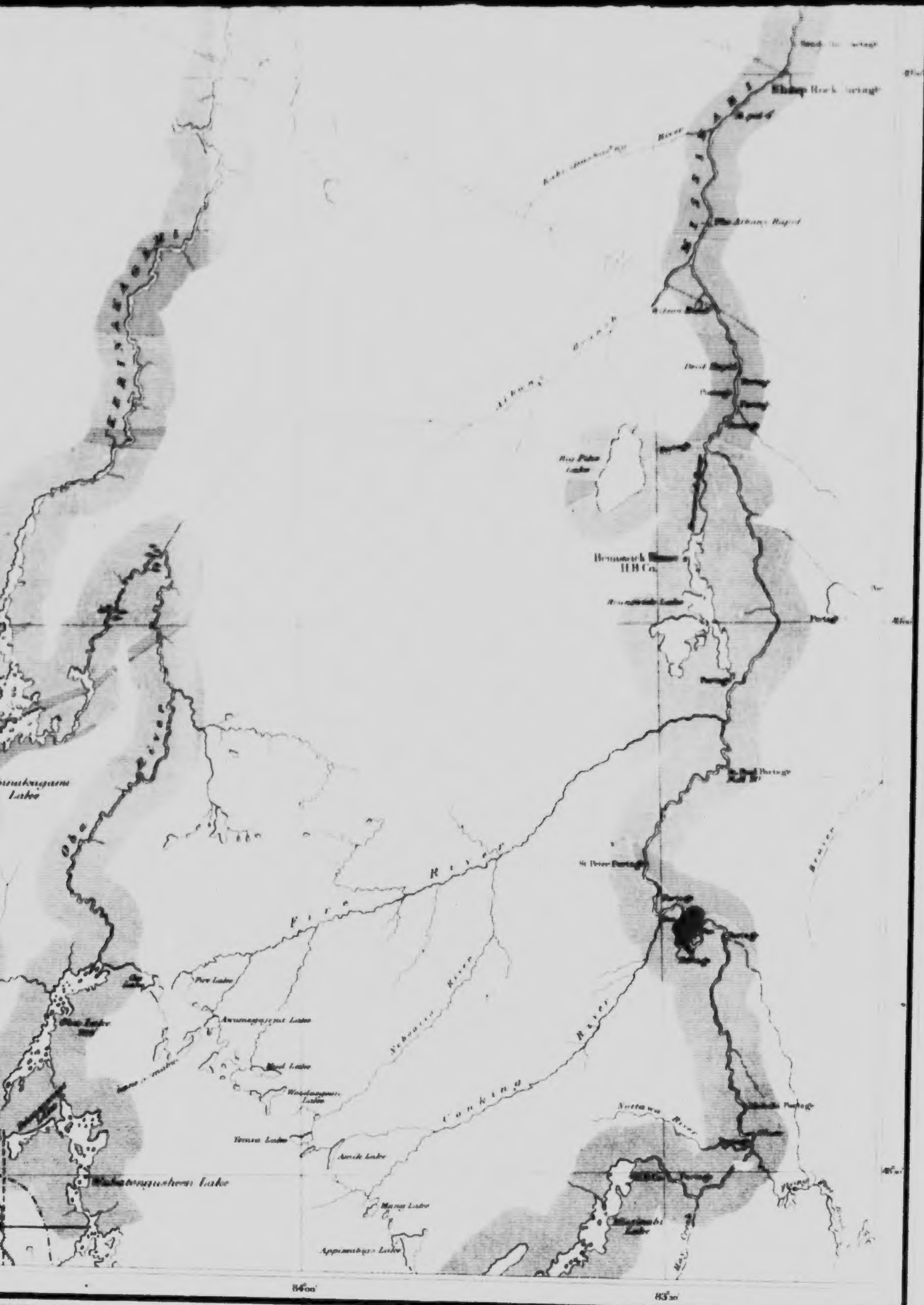
GEOLOGICAL NOTES



C O Senécal B A Sc *Geographer and Chief Draughtsman*


Port Caldwell Harbour
Negwazu Lake
White River
Negwazu Lake


Height of Land
Shell Lake
Whitefish Lake
Wagaman Lake
Pine Lake
Birchwood
Grantsburg
White Rock
Brown
Rice
Portage
Lake
River
Creek



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